City-Wide Storm Drainage Study

for

Grandview, Missouri

1988

86-046-4

EMPLOYEE - OWNED
Burns & McDonnell
ENGINEERS - ARCHITECTS - CONSULTANTS
Kansas City, Missouri

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October 17, 1988

Mr. Larry Finley
City Engineer
City of Grandview
1200 Main Street
Grandview MO 64030

City of Grandview
Storm Drainage Master Plan
Project No. 86-046-4

Dear Mr. Finley:

In accordance with our Agreement of February 25, 1986, we are pleased to submit this City Wide Storm Drainage Study for the City of Grandview.

Burns & McDonnell appreciates the assistance and cooperation that you and your staff have given in providing information and direction during preparation of this report.

Sincerely,

Burns & McDonnell Engineering

Ronald C. Miller

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* * * * *

I - EXECUTIVE SUMMARY

PART I

EXECUTIVE SUMMARY

A. PURPOSE

This summary presents the major conclusions and recommendations for Grandview's Storm Drainage Master Plan. More complete information is contained in the detailed sections of this report.

B. CURRENT LEVEL OF SERVICE

The City was divided into a total of 20 separate watersheds, and computer models of the drainage system were prepared for each. The location and identification of these watersheds is presented on Figure 1, which immediately follows this summary. A total of 850 individual drainage system elements having an aggregate length of over 58 miles were analyzed, including almost 35 miles of presently unimproved open channels.

Less than half of the City's existing major drainage system provides a level of service greater than or equal to the level required by current criteria for new drainage facilities. The following table indicates the modelled performance of the system, which includes all elements other than existing detention facilities.

Table I-1
EXISTING SYSTEM LEVEL OF SERVICE SUMMARY

Return Period Level of Service	Percent of System
≥25 years	29.4
≥10 years	40.4
≥ 5 years	51.4
≥ 2 years	69.5

Neglecting the unimproved open channels included above and considering only the improved portions of the existing system, the overall level of service of the existing system is only slightly improved as indicated below.

Table I-2
EXISTING IMPROVED SYSTEM LEVEL OF SERVICE

Return Period Level of Service	Percent of System
≥25 years	27.7
≥10 years	44.0
≥ 5 years	60.7
≥ 2 years	80.8

The deficiencies in the existing system will become worse in the future as land use changes within the corporate limits as forecast by the City's Comprehensive Land Use Plan increases stormwater runoff. Under future land use conditions, the portion of the entire system with 10-year or greater capacity decreases from 40.4 to 33.2 percent.

C. RECOMMENDED IMPROVEMENTS

It is recommended that the City of Grandview adopt a storm drainage capital improvement program to upgrade the existing major drainage system to provide a level of service consistent with current criteria. The work to complete this program includes 54 separate projects, excluding road culverts, that include:

- o 24,500 feet of pipe and culverts.
- o 2,300 feet of improved open channels.

Undersized road culverts add another 2,000 feet of pipe or box culvert to be improved. In addition to the above lengths, approximately 1,500 feet of pipe and culverts have been improved by the City subsequent to the existing capacity determinations included in this report.

The total length of 28,000 feet of improved pipes and culverts aggregates to slightly over 40 percent of the length of the enclosed system which does not fully meet current criteria under existing conditions. The balance is composed of elements which are not considered the City's responsibility, or are not deficient to an extent that replacement is necessary. A detailed discussion of criteria applied in determination of improvement locations is presented in Part VIII of this report.

Roadway culverts are considered separately from general system improvements as their replacement or expansion should generally be made concurrent with adjacent roadway improvements. In this instance, improvement priority is more directly related to traffic volumes and importance of the roadway than to hydraulic adequacy.

We recommend that the City continue their present policy of requiring that developers include construction of stormwater drainage systems concurrently with their development. Parts of the currently deficient system are open

channels on land zoned for development. Although they lack criteria capacity, they will have no adverse impact until development takes place.

It is further recommended that the projects be constructed in prioritized order. Priorities for specific projects have been developed on an objective basis having the goal of providing the greatest early return on the City's investment measured in terms of the number of property owners relieved of frequent drainage problems. Table I-3, below, summarizes the priority ranking for the proposed projects. Figures 2 through 4 graphically depict the location and recommended prioritization for these projects. However, the actual course of development and the availability of easements should be a continuing consideration by the City in periodically reviewing, updating and modifying priorities to meet changing circumstances.

Table I-3
PROJECT PRIORITY RANKING

Priority Number	Project Number	Watershed	Project Cost
1	1105	LS-D	$733,800
2	601	LN-BC	281,700
3	700	LN-DE	13,300
4	1201	LS-EF	650,700
5	201	B-B	226,500
6	1100	LS-D	16,300
7	701	LN-DE	15,200
8	602	LN-BC	368,800
9	800	LN-F	118,200
10	600	LN-BC	759,600
11	1202	LS-EF	767,100
12	1101	LS-D	109,000
13	1000	LS-C	260,500
14	1501	LS-L	159,300
15	202	B-B	220,100
16	500	LN-A	75,000
17	801	LN-F	47,500
18	1900	OC-B	22,100
19	702	LN-DE	801,100

(cont. next page)

Table I-3
PROJECT PRIORITY RANKING
(Continued)

Priority Number	Project Number	Watershed	Project Cost
20	1401	LS-HIJK	125,000
21	1402	LS-HIJK	320,200
22	1403	LS-HIJK	15,100
23	703	LN-DE	280,100
24	200	B-B	426,500
25	100	B-A	76,200
26	1502	LS-L	87,100
27	1700	LS-Q	21,500
28	1001	LS-C	38,300
29	902	LS-AB	46,600
30	903	LS-AB	271,900
31	501	LN-A	173,900
32	1400	LS-HIJK	61,300
33	1300	LS-G	13,300
34	1600	LS-MNOP	401,700
35	1604	LS-MNOP	309,900
36	1603	LS-MNOP	262,700
37	1601	LS-MNOP	475,300
38	1602	LS-MNOP	288,800
39	1200	LS-EF	259,800
40	1500	LS-L	103,700
41	1102	LS-D	40,700
42	1605	LS-MNOP	361,600
43	1106	LS-D	79,700
44	1606	LS-MNOP	86,100
45	1607	LS-MNOP	239,900
46	101	B-A	388,000
47	900	LS-AB	31,100
48	1702	LS-Q	13,300
49	603	LN-BC	43,100
50	1103	LS-D	69,100
51	1104	LS-D	142,800
52	901	LS-AB	81,000
53	1203	LS-EF	257,000
54	1701	LS-Q	68,400

D. USE OF DETENTION

The potential use of both regulatory and municipally constructed detention facilities was considered in development of the master plan. It was determined that there are only small areas within the City where the use of

detention is of benefit in reducing the need for and cost of downstream drainage system improvements. Those areas are identified in Part VIII of this report.

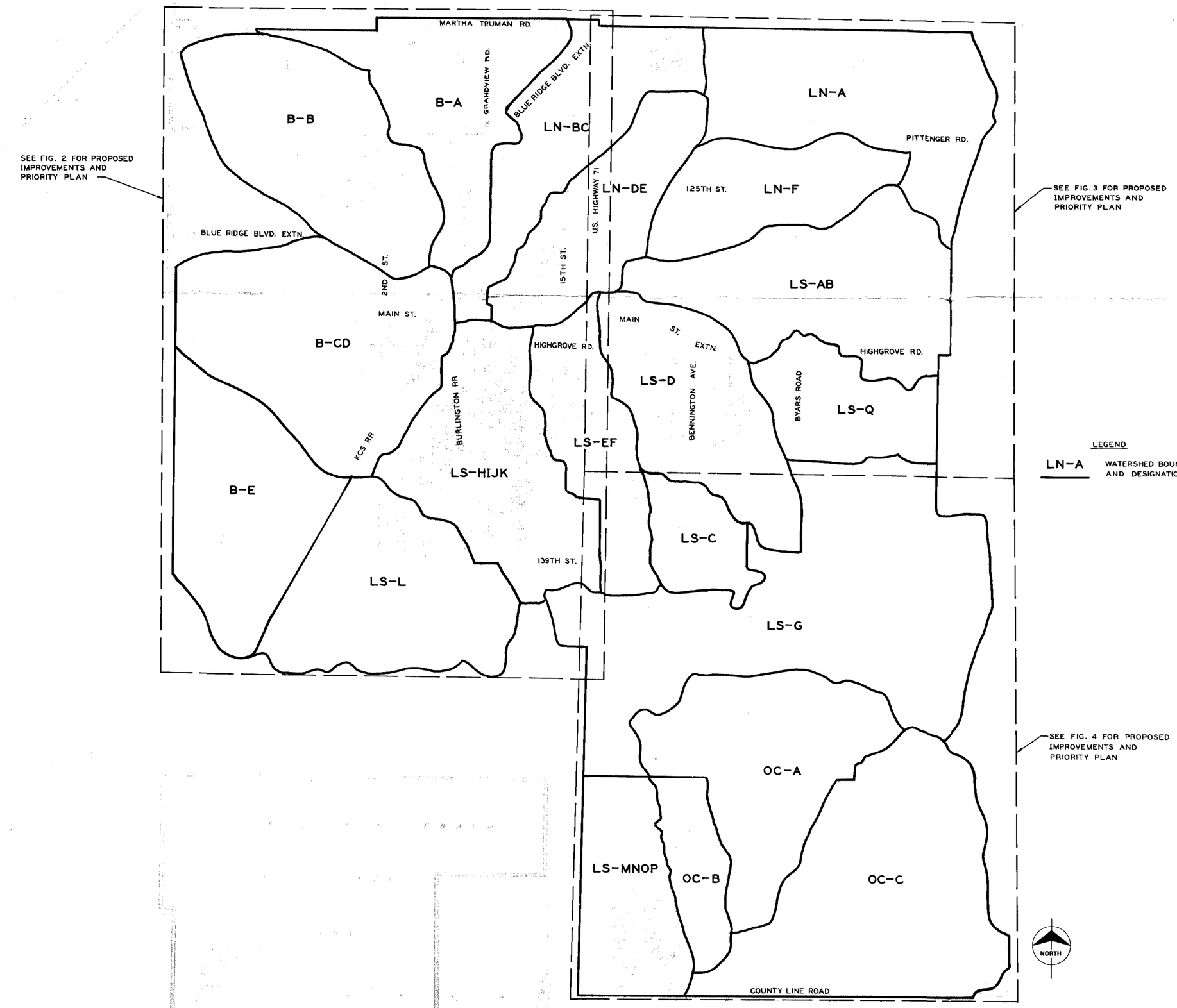
The widespread use of regulatory detention in developing areas of the City was determined to be of little benefit in reducing the scope and cost of eventual improvements. An example is the Oil Creek basin, in which the broad use of regulatory detention would reduce the 10-year flood stage on Oil Creek less than 6 inches below that which would occur were detention not employed.

Nonetheless, the City should retain the option to require detention by specific developments where the development precedes downstream system improvements, and where more detailed analysis of a given area indicates such a need.

E. SYSTEM COSTS

The estimated cost for completion of all recommended City improvements is $13,138,700 at 1988 price levels. Individual project costs range from $13,300 to $801,100. The total estimated cost of $13,138,700 includes $1,532,200 for replacement of road culverts.

* * * * *



no.	date	by	revision

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date	detailed
designed	checked

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STORM DRAINAGE STUDY

project	contract
86-046-4	

drawing — rev.

FIG. 1 —

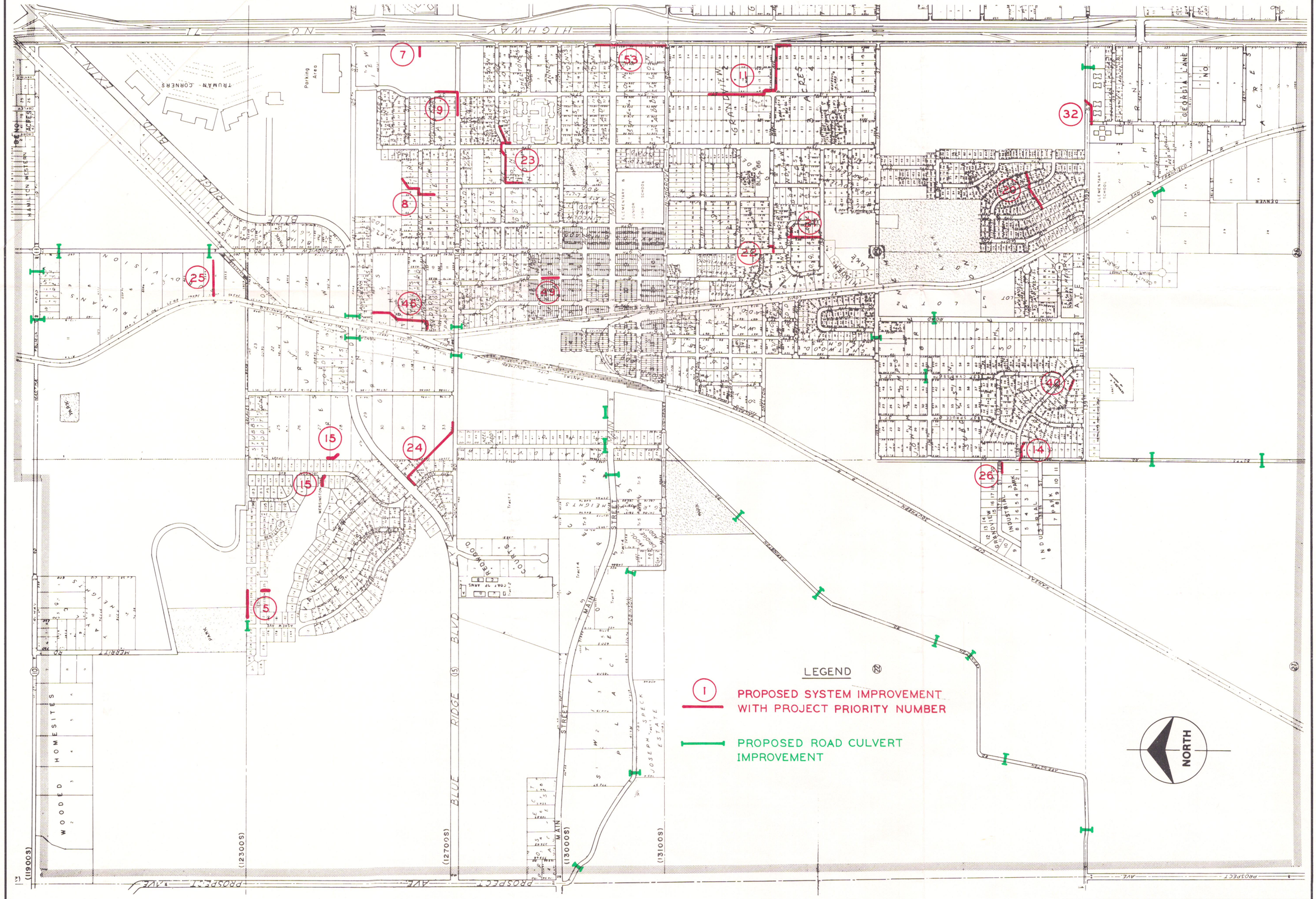

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FIG. 2

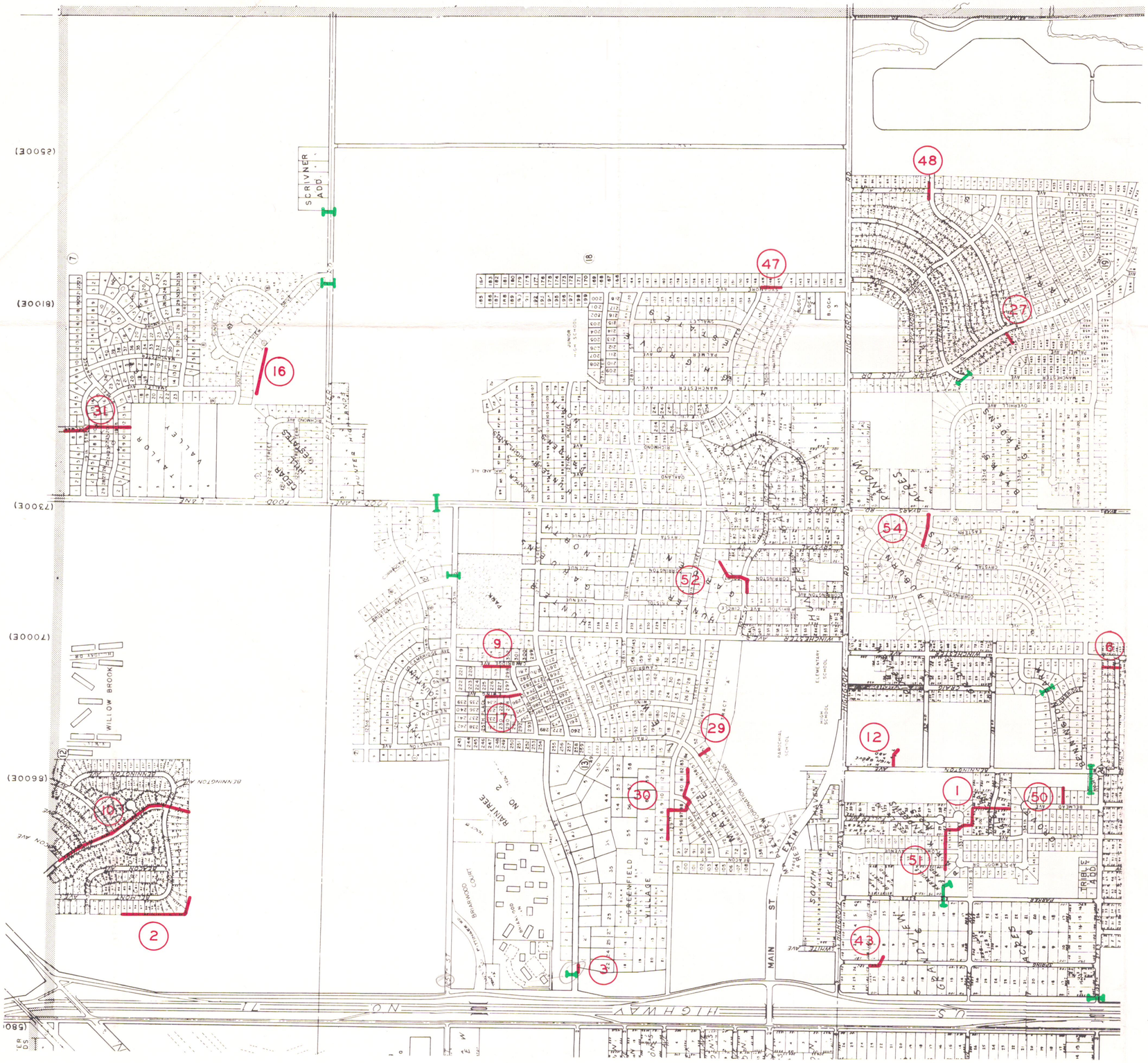

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FIG. 3

LEGEND

(1) PROPOSED SYSTEM IMPROVEMENT WITH PROJECT PRIORITY NUMBER

PROPOSED ROAD CULVERT IMPROVEMENT IMPROVEMENT

NORTH

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FIG. 4

II – GENERAL INFORMATION

PART II

GENERAL INFORMATION

A. AUTHORIZATION AND SCOPE

This study and report were authorized by agreement between the City of Grandview, Missouri and Burns & McDonnell Engineering Company on February 25, 1986. The City's objectives leading to authorization of the work represented by this report were:

- To prevent the recurrence of new and additional drainage problems.
- To correct existing drainage problems as efficiently as possible and in the order that yields the greatest benefits in return for the City's investment in drainage facilities.

The Scope of Services authorized were directed to providing the City with accurate current information on drainage for the entire City that will:

- Establish adequate and detailed technical criteria for system improvements, whether provided by the private sector or the City.
- Define specific major system improvements needed to alleviate damage from storm water.

- o Develop current budget estimates for recommended major system capital improvement projects.

- o Recommend project priorities based on their relative need and cost.

- o Provide maps and information systems for the City to use for their continuing management of drainage.

B. DEFINITION OF TERMS

The following technical terms are used throughout this report. They are defined as follows:

1. "Return Period" - The average frequency that a given event may be expected to occur. It is a statistical term and does not imply that the event will occur regularly at even intervals. For instance, a storm having a 10-year frequency statistically can be expected to occur 10 times within a period of 100 years. However, the event may happen at any time. As an example, two 10-year events may occur in successive years or even on successive days.

2. "Storm Drainage System" - All of the natural and man-made facilities and appurtenances, such as ditches, natural channels, pipes, culverts, bridges, open improved channels, street gutters, inlets and detention facilities that serve to collect and convey surface drainage within the City.

3. "Reach" - A specific length of the storm drainage system between two points. For example, a reach may consist of a single culvert or may consist of several connected pipes or channel sections.

4. "Thalweg" - The lowest point in a ditch or culvert. It is synonymous with the term "flow line."

5. "Hydraulic Gradient" - The elevation of the surface of water in the drainage system at any point.

6. "Detention Facility" - Any structure, device or combination thereof that functions to accept inflow from surface runoff and discharge it at a controlled rate less than the peak inflow rate.

7. "Development" - Any activity that alters the surface of the land to create additional impervious surfaces including, but not limited to, pavement, buildings and structures.

8. "Watershed" - All land draining to the storm drainage system at any given point. This term is used synonymously with "tributary area."

9. "Natural Channel" - An existing channel that has not been appreciably altered by lining or changing its course.

10. "Improved Channel" - Any channel whose characteristics are changed by either grading or construction of lining materials.

11. "Enclosed Drainage System" - A drainage system consisting of essentially continuous pipes and/or culverts below the ground surface.

12. "Open System" - A drainage system consisting of open channels with only comparatively short lengths enclosed by pipes or culverts.

13. "Erosion" - The removal of soil particles by the action of flowing water.

14. "Sediment" - Soil particles eroded by flowing water, either in suspension in that water or as deposited.

15. "Freeboard" - The vertical difference in elevation between the hydraulic gradient and a referenced point. Examples are the difference between the maximum water surface level behind a dam and the top of a dam or the difference in elevation between the water surface at a culvert beneath the roadway and the surface of the roadway.

16. "Impervious Surface" - Any surface that does not readily permit water to enter. Examples are roofs and concrete or asphalt-paved surfaces.

17. "Pervious Surfaces" - Surfaces that absorb water such as yards and other unpaved areas.

18. "Developer" - Any person or corporation engaged in the process of changing the use of land.

C. STORM DRAINAGE SYSTEMS

There are two storm drainage systems in the City. Each must perform its function adequately to provide an acceptable level of drainage service. However, the consequences of poor performance by each system differ greatly. These systems are the "Minor System" and the "Major System."

The Major System may be considered as analogous to the City's arterial streets that serve to carry large volumes of traffic through the City. The Minor System may be considered analogous to the City's residential streets that serve to collect traffic from each driveway and carry it to the major streets for passage through the City.

Substandard performance by the Major System is usually associated with significant consequences. When it fails to perform, comparatively large volumes of water overflow streets and property and may cause real damage by both erosion and flooding of buildings. The failure of the Minor System to perform is characterized by lower volume, shorter duration overflows that may, on occasion, be a nuisance to traffic or cause objectionable quantities

of water to flow across property although real damage is normally not experienced.

There is no clear line of demarcation between the Major and Minor Systems. In general, the major system is considered to begin at the point at which approximately 40 acres become tributary or at which the peak discharge from a 10-year storm event would equal 100 cu ft/sec. This study and report are directed to both systems, although the primary emphasis is on the major system.

* * * * *

III – TECHNICAL CRITERIA AND METHODOLOGY

PART III

TECHNICAL CRITERIA AND METHODOLOGY

A. FIELD INVESTIGATION

A field reconnaissance survey was conducted to observe and confirm physical features of the existing major drainage system throughout the City and develop data identifying the hydrologic parameters of drainage subareas within the major watersheds. The field work was accomplished by two-man crews consisting of an experienced professional engineer and an engineering technician. Specific data regarding reach size, configuration, and hydraulic conditions were obtained and recorded for nearly all of the over 800 individual reach elements modelled. In addition to measured data, notes were taken concerning the apparent physical condition and state of maintenance of many storm drainage structures, both City-owned and private.

Field information was recorded on forms developed to record pertinent hydraulic and hydrologic data for each reach of the system surveyed. In addition to verifying sizes and materials of existing enclosed system and culvert elements, the following information was obtained:

- o Channel/culvert depth capacity to overflow or structural damage:

  Measurements were made of the available headwater (freeboard) at principal culverts before overflow of the roadway or downstream property begins. Also measured was the elevation difference between the grade of open channels and the lowest adjacent structure. These data were later

used in office studies to evaluate allowable flow depths in the system reaches.

- o Open channel conveyance capacity: Cross sections were measured for important open-channel reaches on the major system.
- o Hydraulic roughness coefficients: Roughness coefficients (Mannings "N") values were estimated and recorded for all system reaches in their existing condition. Table III-1 following indicates the standards applied for estimating existing roughness coefficients.

Table III-1

FIELD EVALUATION STANDARDS FOR ROUGHNESS COEFFICIENTS

Conveyance Structure	Manning's "N"
Closed Conduits	
Reinforced Concrete Pipe	.013
Corrugated Metal Pipe	.023
Reinforced Concrete Box Culverts:	
a. Single Barrel	.013
b. Multiple Barrel, Effective	.0155
Stone or Brick Masonry	.022
Improved Open Channels	
Full Concrete Lining - Good Condition	.015
Full Concrete Lining - Minor Joint Problems	.017
Full Concrete Lining - Advanced Deterioration	.020
Full Asphalt Lining - Good Condition	.017
Full Asphalt Lining - Poor Condition	.020
Grouted Masonry - Good Condition	.023
Grouted Masonry - Poor Condition	.030
Riprap	.035
Concrete Invert - Maintained Turf Sides	.020
Concrete Invert - Moderate Brush/Shrub Sides	.030
Concrete Invert - Tree and/or Improvement Obstruction	.035
Concrete Invert - Appreciable Fences	.045
Turfed - Clean, Few Obstructions	.030
Turfed - Moderate Obstructions	.035
Turfed - Severe Obstructions	.045
RR Tie - One Bank	.023
RR Tie - Both Banks	.020

TABLE III-1 (cont.)

Concrete Block Sides - Concrete Bottom	.019
Concrete Block Sides - Earth or Turf Bottom	.023
Natural Ditches or Channels	
Straight to Moderately Sinuous	
Clean Earth Banks, Earth Bottom or Smooth Rock	.030
Clean Earth Banks, Rough Rock Bottom	.035
Brushy Banks - Few Obstructions	.040
Brushy Banks - Significant Obstructions	.050
Debris and/or Weed Choked	.070
Overbank Floodways	
Street R/W Perpendicular to Flow	.035
Yards - Open Grass	.030
Yards - Grass - Some Bushes and Trees	.040
Yards - Significant Trees and Bushes	.050
Unimproved - Weedy - Moderate Brush	.050
Unimproved - Heavy Brush and Trees	.060
Unimproved - Dense	.100
Unimproved - Open	.040

B. SYSTEM MAPPING

The existing storm drainage system within the City was mapped at a scale of 1-inch equals 100 feet. Overlay drafting techniques were used. The City's aerial topographic base mapping formed the map base. Information concerning the location of existing pipes, conduits, inlets, and drainage structures was obtained by reference to the City's files and records maintained by the Public Works Department and supplemented by information obtained during the field investigation phase of the work.

During the office study phase the system maps were expanded to include definition of watershed boundaries and drainage areas tributary to each modeled reach of the major drainage system. Then they were keyed and coded to correspond to the computer models used for performance evaluation and

confirmation of system hydraulic capacity. The completed maps include data for 788 modeled subdrainage areas and 850 discrete system reaches. The completed maps have been separately furnished to the City.

C. OFFICE STUDIES

D. GENERAL

Office studies were conducted to accomplish the following objectives.

- o Define the performance level of the present drainage system under conditions of current land use and development.
- o Define the hydraulic demand on the drainage system under conditions of future land use as defined by the City's Comprehensive Plan.
- o Confirm the performance capacity of the system as improved by recommendations contained in other sections of this report.
- o Evaluate alternative system improvement possibilities and evaluate the effect of various sequences and priorities of recommended improvements.

1. COMPUTER MODELLING

Three computer programs, developed by Burns & McDonnell for storm drainage managment planning, were employed to model the existing and proposed drainage systems, to estimate the costs of improvements, and to prioritize recommended improvements.

a. URBMOD Program

The URBMOD program was used to analyze both the existing and proposed systems. It is a program for modeling the performance of a complex urban drainage system consisting of any combination of pipes, open channels, box culverts, or detention basins. The program may be applied to:

- o Evaluate the capacity and performance of any defined drainage system.
- o Design a drainage system to provide a given level of service.
- o Determine the effect of land use changes on drainage system performance.
- o Determine the effect of improvements of any part of the drainage system on all other parts of the system.

Operation provides for the simultaneous routing through both structural system components such as pipes, box culverts, etc., and through surface overflow channels such as gutters and swales, to the extent the planned system capacity is exceeded.

Data files are created through the use of the dedicated data entry program URBDAT. Input data to the model, utilizing information and data acquired and developed during the field investigation and office study phases of the technical work, include the following.

For each discrete drainage subarea:

- o Soil Conservation Service (SCS) curve number.
- o Surface area.
- o Hydraulic length of overland flow to the main channel reach considering the combined effect of flow over land surfaces, in street gutters and in minor system ditches and culverts.
- o Average slope of the subarea perpendicular to the reach.

For each reach or line in the system:

- o Directly tributary upstream lines.
- o Type of line (pipe, box culvert or channel).
- o Length.
- o Slope.
- o Cross section (depth, width and side slope).
- o Roughness coefficient.
- o Hydraulic parameters of overflow channel.

Output data for each reach of the system includes:

- o Time of peak.
- o Type of hydraulic control at peak.
- o Duration system capacity is exceeded.
- o Peak in-system capacity.

- o Peak discharge.
- o Maximum depth.
- o Maximum storage.

b. SYCOST Program

The SYCOST program was used for preliminary improved facility design and later developed cost estimates for the most feasible proposed improvements. It is a program primarily for estimating the budget grade costs of storm drainage systems for study and planning purposes. The program performs conceptual grade design of component system facilities, then estimates their cost using current unit prices for key items. It accommodates the following types of storm drainage system components.

- o Conventional pipe systems with pipe sizes up to 96 inches diameter.
- o Box culverts, single and multiple span.
- o Lined open channels.
- o Natural channels.
- o Site specific detention facilities.

Input data common to all reaches is:

- o Structure type.
- o Design discharge.

- o Detention storage (if applicable).
- o Depth limitations (if applicable).
- o Length.
- o Location code (existing or new R.O.W.).
- o Structure size (if previously determined).

Output data for each reach includes:

- o Structure type and size.
- o Cost estimates for
  - Construction
  - Land
  - Fees & contingencies.
  - Total capital cost.
  - Annual maintenance cost.

c. PRIOR Program

The PRIOR program was utilized with the recommended improvement plan to priority rank a series of projects made up of the reaches proposed for improvement. It is a model for developing rational and logical priorities among discrete "projects" included in a large scale program or proposal for storm water system improvements. The model design is biased to assign the highest priorities to those projects that relieve deficiencies benefitting the greatest number of people at the lowest capital cost per benefitted system "user".

Operation of the model sequentially determines a "score" for each project on an internally weighted scale, then differentiates between equal "score" projects by secondary level comparison of component factors to establish an absolute priority ranking of all projects within the model. The evaluation scale used to determine project scores is presented in Table III-2 at the end of this section.

Discrete parameters analyzed for each project in the model are:

- o Frequency of damage from overflow of the existing system.
- o Number of damaged properties.
- o Type of damage:
  - Structure and/or contents damage.
  - Erosion damage only.
  - Nuisance only with no direct economic damage.
- o Frequency of existing system overflow.
- o Effect of inadequate system on future land development.
- o Structural condition of an existing facility, if present.
- o Magnitude of the absolute hydraulic deficiency.
- o Capital cost of the project.

Output data from this program includes the following for each project:

- o Priority number.

- o Priority points (or raw score).
- o Capital cost.
- o Priority control which is the model's justification for assigning that project's priority.

TABLE III-2

PROJECT PRIORITY EVALUATION SCALE

	Priority Factor	Unit	Amount	Points
1.	Frequency of Structure and Contents Damage	Yrs. Ret. Period	=<2 Yr. Freq.	3
			2-5 Yr. Freq.	2
			5-10 Yr. Freq.	1
			> 10 Yr. Freq.	0
2.	Relative Magnitude of Damage	No. of Real Properties		
	a. Structural and Contents		0	0
			=< 2	2
			2-5	5
			5-10	10
			> 10	20
			0	0
	b. Erosion		=< 2	1
			2-5	2
			5-10	4
			> 10	5
			0	0
	c. Nuisance		< 10	1
			>=10	2
3.	Frequency of Hydraulic Inadequacy	Yrs. Ret. Period	=<2	3
			2-5	2
			5-10	1
			> 10	0
4.	Affect on City Development	Undeveloped Upstream Acres	<=1	0
			1-5	1
			5-10	3
			> 10	4

PROJECT PRIORITY EVALUATION SCALE (continued)

Priority Factor	Unit	Amount	Points
7. Capital Cost Per Benefitted Property	Dollars	< $1,000	6
		$ 1,000-$ 5,000	5
		$ 5,000-$10,000	4
		$10,000-$20,000	2
		$20,000-$30,000	1
		$30,000 & >	0
5. Structural Condition of Existing Facility	Condition	No Facility	0
		Good	0
		Poor	1
6. Magnitude of 10-Year Hydraulic Deficiency	CFS	< 100	2
		100-500	3
		> 500	5

* * * * *

IV – EXISTING SYSTEM PERFORMANCE

IV - EXISTING SYSTEM PERFORMANCE

A. GENERAL

This section presents a summary of the results of the detailed hydrologic and hydraulic analyses of the 20 watersheds within the corporate limits of Grandview. These analyses are based on land usage and the storm drainage system as they existed in mid to late 1986.

1. MODEL DEVELOPMENT

Separate models were developed for each of the 20 watersheds. A summary description of the content of the 20 models is presented in Table IV-1.

Table IV-1

EXISTING SYSTEM
MODEL DESCRIPTION

Watershed	Subareas (No.)	Drainage Elements (No.)	Outlets (No.)	Modelled Area* (ac.)	Additional Area** (ac.)	Modelled System Length*** (ft.)
B-A	49	53	5	465	0	15,225
B-B	34	37	1	553	0	15,995
B-CD	47	52	3	792	0	24,130
B-E	17	17	3	374	0	9,410
LN-A	34	40	1	494	540	21,105
LN-BC	43	46	1	416	150	19,230
LN-DE	42	44	1	360	0	16,310
LN-F	26	29	1	281	0	12,195
LS-AB	56	65	1	496	0	20,465
LS-C	34	40	5	131	0	8,105
LS-D	72	77	1	414	0	19,625
LS-EF	37	39	1	263	0	12,515
LS-G	35	37	9	463	0	12,570
LS-HIJK	60	65	1	495	0	19,405
LS-L	37	38	3	491	0	17,585
LS-MNOP	42	44	6	267	39	9,620
LS-Q	47	48	5	228	0	11,030
OC-A	40	42	1	482	0	20,460
OC-B	13	14	1	162	0	4,880
OC-C	23	23	2	715	2,925	17,820
TOTAL	788	850	52	8,342	3,654	307,680

*Within corporate limits of Grandview.
**Tributary area outside corporate limits of Grandview.
***Excludes length occupied by existing detention facilities.

2. ADDITIONAL DATA AND INFORMATION

In addition to the information presented in this report, the following is a summary of the additional information and data transmitted to the City of Grandview relative to the existing storm drainage system.

- o "URBDAT" data files for each of the 20 existing conditions watershed models.

- o "URBMOD" executable files for each of the 20 existing conditions watershed models.

- o Existing conditions chaining files for the 2, 5, 10 and 25 year events for the following watersheds:
  - LN-A (LN-BC, LN-DE, and LN-F tributary)
  - LS-EF (LS-HIJK tributary)
  - OC-A (OC-B and OC-C tributary)

- o Sixty original, correctable mylar overlays graphically depicting the existing conditions models at a scale of 1"=100'.

- o Sixty system maps (uncorrectable) presenting a composite of the existing conditions models and currently available topographic mapping at a scale of 1"=100'.

- o Original copies of field report forms prepared during the conduct of the field inventory.

B. SYSTEM SUMMARY ANALYSIS

The full-flow capacity of all components of the major drainage system was determined, and then compared to existing demand discharges resulting from events having return periods of 2, 5, 10, and 25 years. This gives definition of the level of drainage service provided by the various facilities.

A summary analysis of the level of service afforded by the various types of drainage systems is presented in Table IV-2. This table excludes only existing storm water detention facilities, which are separately discussed.

Table IV-2

ALL EXISTING WATERSHEDS
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	70,265	0	(53)	2,605	20,970	93,840
2 yr.-5 yr.	30,930	3,400	(13)	1,060	20,360	55,750
5 yr.-10 yr.	13,480	1,985	(15)	1,285	17,205	33,955
10 yr.-25 yr.	13,750	3,920	(14)	1,110	15,000	33,780
>25 yr.	56,225	9,480	(44)	3,690	20,960	90,355
TOTAL	184,650	18,785	(139)	9,750	94,495	307,680

As indicated above, 29.4 percent of the existing system has a full-flow capacity equal to or greater than the 25-year discharge; the 10-year discharge, 40.4 percent; the 5-year discharge, 51.4 percent; and the 2-year discharge, 69.5 percent.

GRP4.SMP

Neglecting unlined channels (which are, with limited exceptions, unimproved open channels), the level of service provided by the improved drainage system is summarized in Table IV-3.

Table IV-3

IMPROVED DRAINAGE SYSTEMS
EXISTING LEVEL OF DRAINAGE SERVICE

Level of Service	Total Length (ft.)	Percent of Improved System (%)
>25 yr.	34,130	27.7
>10 yr.	54,160	44.0
>5 yr.	74,635	60.7
>2 yr.	99,455	80.8
TOTAL LENGTH	123,030	

1. DETENTION FACILITIES

The existing system models include a total of 18 elements which presently act as storm water detention facilities. These include 1 industrial impoundment, 5 recreational impoundments, 9 agricultural impoundments, and 3 regulatory (dedicated) detention facilities. A summary listing of those facilities is presented in Table IV-4.

Table IV-4

EXISTING DETENTION FACILITIES

Watershed	Line No.	Type	Storage Capacity* (ac-ft.)	Storage Capacity* (in. runoff)	Ann. Probability of Over Topping
B-A	1010	Indust.	80	3.3	<4%
B-A	2060	Reg.	7.5	2.5	<4%
B-B	1060	Rec.	8	0.7	±7%
B-B	1090	Rec.	5	0.7	>50%
B-CD	1150	Rec.	3	0.1	±10%
B-CD	1160	Rec.	36	2.1	<4%
B-CD	1260	Reg.	3	4.0	<4%
B-E	2020	Agric.	1.5	0.6	<4%
B-E	2030	Agric.	0.9	0.5	<4%
B-E	3010	Agric.	6	0.6	<4%
LS-G	1130	Agric.	2.2	0.5	<4%
LS-G	1140	Agric.	1.0	0.3	<4%
LS-G	1210	Agric.	1.8	0.5	<4%
LS-HIJK	2090	Reg.	0.7	0.8	<4%
LS-HIJK	2350	Rec.	10	0.9	±35%
OC-A	1290	Agric.	4	3.2	<4%
OC-C	3020	Agric.	30	1.9	<4%
OC-C	3030	Agric.	12	1.0	<4%

*Above normal water level.

2. CONVEYANCE FACILITIES

Conveyance facilities are generally separated into the following four categories:

- o Unlined channels.
- o Lined channels.
- o Roadway culverts.
- o Enclosed system.

The following is a summary analysis of the level of drainage service presently afforded by each of the above four categories.

a. Unlined Channels

This general category encompasses fully 60 percent of the major drainage system within the City of Grandview, and is comprised primarily of unimproved (natural) open channels. Table IV-5 presents a summary analysis of the level of service afforded by this type of facility.

Table IV-5

EXISTING SYSTEM PERFORMANCE
UNLINED CHANNELS

	Existing System Capacity					
Watershed	<2 Yr. (ft.)	2 Yr.-5 Yr. (ft.)	5 Yr.-10 Yr. (ft.)	10 Yr.-25 Yr. (ft.)	>25 Yr. (ft.)	Total
B-A	3,125	800	0	370	4,890	9,185
B-B	4,685	5,230	1,610	1,450	380	13,355
B-CD	10,600	7,100	0	1,890	3,250	22,840
B-E	6,700	1,090	0	1,500	0	9,290
LN-A	9,645	800	2,170	970	2,700	16,285
LN-BC	2,850	0	350	0	2,000	5,200
LN-DE	4,800	0	0	1,000	950	6,750
LN-F	0	0	0	1,600	5,305	6,905
LS-AB	900	650	580	600	5,700	8,430
LS-C	1,810	620	500	0	120	3,050
LS-D	780	1,570	650	2,110	720	5,830
LS-EF	1,600	2,160	1,020	0	2,160	6,940
LS-G	1,900	2,560	2,320	0	3,120	9,900
LS-HIJK	320	1,630	400	0	3,860	6,210
LS-L	4,940	1,580	0	2,260	5,820	14,600
LS-MNOP	0	0	0	0	1,560	1,560
LS-Q	900	0	0	0	0	900
OC-A	7,010	2,870	1,000	0	5,610	16,490
OC-B	400	1,020	0	0	1,780	3,200
OC-C	7,300	1,250	2,880	0	6,300	17,730
TOTAL	70,265	30,930	13,480	13,750	56,225	184,650

b. Lined Channels

Lined channels within the City of Grandview constitute, but 6.1 percent of the City's major storm drainage system, and are composed primarily of concrete-lined channels. Table IV-6 presents a summary analysis of the level of service afforded by this type of facility.

Table IV-6

EXISTING SYSTEM PERFORMANCE
LINED OPEN CHANNELS

	Existing System Capacity					
Watershed	<2 Yr. (ft.)	2 Yr.-5 Yr. (ft.)	5 Yr.-10 Yr. (ft.)	10 Yr.-25 Yr. (ft.)	>25 Yr. (ft.)	Total
B-A	0	0	0	0	80	80
B-B	0	0	0	0	0	0
B-CD	0	0	0	0	0	0
B-E	0	0	0	0	0	0
LN-A	0	0	0	670	0	670
LN-BC	0	0	0	400	1,150	1,550
LN-DE	0	0	0	0	0	0
LN-F	0	0	0	0	0	0
LS-AB	0	0	420	1,290	2,640	4,350
LS-C	0	0	0	0	0	0
LS-D	0	730	690	120	1,900	3,440
LS-EF	0	0	0	0	440	440
LS-G	0	0	0	0	0	0
LS-HIJK	0	730	0	230	2,120	3,080
LS-L	0	0	340	1,210	200	1,750
LS-MNOP	0	0	0	0	0	0
LS-Q	0	1,640	535	0	600	2,775
OC-A	0	300	0	0	0	300
OC-B	0	0	0	0	350	350
OC-C	0	0	0	0	0	0
TOTAL	0	3,400	1,985	3,920	9,480	18,785

c. Roadway Culverts

This classification includes 139 culverts representing 3.2 percent of the length of the City's major drainage system. Included in this category are all major system culverts beneath roadways, railways, highways, and private drives, other than those existing as a part of an extended enclosed system. The performance of these culverts is summarized in Table IV-7.

Table IV-7

EXISTING SYSTEM PERFORMANCE
ROADWAY CULVERTS*

	Existing System Capacity											
	<2 Yr.		2 Yr.-5 Yr.		5 Yr.-10 Yr.		10 Yr.-25 Yr.		>25 yr.		Total	
Watershed	(No)	(ft.)	(No)	(ft.)	(No)	(ft.)	(No)	(ft.)	(No)	(ft.)	(No)	(ft.)
B-A	(8)	340	(2)	200	(1)	40	(0)	0	(6)	540	(17)	1,120
B-B	(3)	165	(0)	0	(2)	85	(1)	50	(1)	50	(7)	350
B-CD	(11)	520	(1)	50	(0)	0	(0)	0	(5)	300	(17)	870
B-E	(3)	90	(0)	0	(0)	0	(0)	0	(1)	30	(4)	120
LN-A	(1)	30	(1)	40	(0)	0	(1)	40	(4)	460	(7)	570
LN-BC	(1)	50	(0)	0	(2)	440	(0)	0	(2)	270	(5)	760
LN-DE	(1)	80	(0)	0	(0)	0	(0)	0	(3)	340	(4)	420
LN-F	(2)	70	(0)	0	(0)	0	(0)	0	(0)	0	(2)	70
LS-AB	(0)	0	(0)	0	(1)	40	(2)	110	(5)	555	(8)	705
LS-C	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0
LS-D	(1)	140	(2)	240	(4)	230	(1)	50	(4)	190	(12)	850
LS-EF	(5)	360	(1)	60	(1)	210	(1)	50	(2)	90	(10)	770
LS-G	(4)	120	(4)	370	(1)	60	(1)	80	(0)	0	(10)	630
LS-HIJK	(6)	300	(1)	30	(0)	0	(3)	550	(3)	320	(13)	1,200
LS-L	(3)	90	(1)	70	(2)	160	(1)	40	(1)	45	(8)	405
LS-MNOP	(2)	100	(0)	0	(1)	20	(0)	0	(2)	70	(5)	190
LS-Q	(1)	60	(0)	0	(0)	0	(1)	50	(0)	0	(2)	110
OC-A	(1)	90	(0)	0	(0)	0	(0)	0	(3)	170	(4)	260
OC-B	(0)	0	(0)	0	(0)	0	(0)	0	(2)	260	(2)	260
OC-C	(0)	0	(0)	0	(0)	0	(2)	90	(0)	0	(2)	90
TOTAL	(53)	2,605	(13)	1,060	(15)	1,285	(14)	1,110	(44)	3,690	(139)	9,750

*Includes all roadway, railroad, and private drive culverts included in models.

d. Enclosed System

Enclosed drainage elements represent 30.7 percent of the City's major drainage system, second only to the unimproved open channels. The level of service provided by the City's enclosed system is presented in Table IV-8.

Table IV-8

EXISTING SYSTEM PERFORMANCE
ENCLOSED SYSTEM

	Existing System Capacity					
Watershed	<2 Yr. (ft.)	2 Yr.-5 Yr. (ft.)	5 Yr.-10 Yr. (ft.)	10 Yr.-25 Yr. (ft.)	>25 Yr. (ft.)	Total
B-A	1,760	450	240	170	2,220	4,840
B-B	0	600	685	860	145	2,290
B-CD	420	0	0	0	0	420
B-E	0	0	0	0	0	0
LN-A	0	790	505	470	1,815	3,580
LN-BC	3,920	3,375	1,835	1,880	710	11,720
LN-DE	1,210	1,060	2,405	1,865	2,600	9,140
LN-F	380	670	975	1,650	1,545	5,220
LS-AB	150	3,185	1,955	915	775	6,980
LS-C	385	1,380	725	1,415	1,150	5,055
LS-D	2,080	2,700	1,990	685	2,050	9,505
LS-EF	3,210	50	540	360	205	4,365
LS-G	60	310	560	630	480	2,040
LS-HIJK	1,415	1,980	2,170	1,910	1,440	8,915
LS-L	130	440	80	0	180	830
LS-MNOP	4,950	870	560	100	1,390	7,870
LS-Q	620	1,370	750	1,250	3,255	7,245
OC-A	120	1,130	880	840	440	3,410
OC-B	160	0	350	0	560	1,070
OC-C	0	0	0	0	0	0
TOTAL	20,970	20,360	17,205	15,000	20,960	94,495

C. WATERSHED SUMMARIES

This section presents additional detail on the performance of the existing drainage system watershed by watershed, and includes the estimated capacity and demand discharge on each element of the major drainage system.

1. WATERSHED B-A

Watershed B-A encompasses a total of 465 acres tributary to a series of culverts beneath Martha Truman Road in the northwest quadrant of the City. Of that total area, 307 acres are tributary to an 8'x4' RCB beneath Martha Truman Road approximately 2200 feet west of Grandview Road.

Substantial areas of developable land exist in this watershed. For much of its length, the primary drainage channel is flanked by previous industrial development. Elements of the drainage system have been, and are being, enroached upon by activities associated with the industrial developments.

A total of 49 subareas and 53 discrete pipe, channel, or culvert reaches were modelled for this watershed. Pertinent data for the area tributary to the primary outlet is summarized below:

Drainage Area:	307.21 ac.
Watershed Hydraulic Length:	7,210 ft.
Percent of Length Improved:	39.0 percent
Maximum Elevation:	1,071 ft. m.s.l.
Minimum Elevation:	951 ft. m.s.l.
Composite S.C.S. Curve Number:	78.9

Table IV-9 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-10.

Table IV-9

WATERSHED B-A, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	8'x4' RCB	480	41	76	105	142
1010	Detention Facility	294	39	73	102	137
1020	36" RCP	106	13	22	29	36
1030	Unlined Channel	85	35	57	75	96
1040	Unlined Channel	57	16	26	34	43
1050	18" CMP	8	10	17	22	28
1060	Unlined Channel	315	214	340	411	506
1070	24" CMP	18	218	337	415	504
1080	Unlined Channel	20	219	344	422	512
1090	Unlined Channel	16	43	72	92	118
1100	24" CMP	22	36	61	76	99
1110	24" RCP	34	22	37	48	61
1120	2'x1.5' RCB	23	20	34	44	56
1130	Unlined Channel	18	173	261	314	369
1140	24" CMP	18	19	21	21	21
1150	24" CMP	18	15	20	20	21
1160	Unlined Channel	38	160	241	286	330
1170	Unlined Channel	894	149	223	262	308
1180	2'x1.5' RCB	28	28	40	48	57
1190	Unlined Channel	85	27	38	46	55
1200	15" RCP	8	15	21	25	30
1210	1-60" CMP, 2-36" RCP	308	108	163	188	214
1220	Unlined Channel	385	109	164	188	216
1230	24" RCP	20	9	14	17	20
1240	8'x3' RCB	199	97	146	165	185
1250	36"x22" CMP	37	15	22	29	34
1260	8'x2' RCB	135	77	117	128	141
1270	Unlined Channel	440	77	116	128	140
1280	6'x3' RCB	152	76	114	125	135

(continued next page)

Table IV-9
(continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1285	P.C.C. Lined Channel	260	76	116	125	136
1290	Unlined Channel	66	68	103	114	118
1300	50"x31" CMPA	29	63	93	101	102
1310	36" CMP	34	40	59	74	91
1320	Unlined Channel	20	29	43	54	66
1330	Unlined Channel	149	24	35	43	53
1340	27" CMP	20	21	32	40	48
2000	4'x2.5' RCB	137	78	114	141	191
2010	48" CMP	92	24	33	40	48
2020	43"x27" CMPA	46	23	32	39	46
2030	21" RCP	25	21	29	36	43
2040	Unlined Channel	140	52	78	96	144
2050	27" CMP	21	33	49	60	120
2055	24" RCP	28	17	26	33	91
2060	Detention Facility	31	15	23	30	83
2070	48" CMP, PCC Lined	88	24	33	39	47
2080	48" CMP, PCC Lined	88	25	33	40	47
3000	12" RCP	6	14	22	27	34
4000	4'x2.5' RCB	150	25	42	55	70
4010	Unlined Channel	139	22	37	48	61
5000	4'x2.5' RCB	150	43	73	96	124
5010	Unlined Channel	140	34	57	75	98
5020	2-24" RCP	92	26	43	57	73
5030	Unlined Channel	115	24	41	54	70

Table IV-10

WATERSHED B-A, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	3,125	0	(8)	340	1,760	5,225
2 yr.-5 yr.	800	0	(2)	200	450	1,450
5 yr.-10 yr.	0	0	(1)	40	240	280
10 yr.-25 yr.	370	0	(0)	0	170	540
>25 yr.	4,890	80	(6)	540	2,220	7,730
TOTAL	9,185	80	(17)	1,120	4,840	15,225

The model for watershed B-A includes a total of two detention facilities. Pertinent data on those facilities is summarized in the following table.

Table IV-11

WATERSHED B-A, EXISTING
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized 2 Yr. (ac-ft)	5 Yr. (ac-ft)	10 Yr. (ac-ft)	25 Yr. (ac-ft)
1010	Private, Industrial	293.87	80	19.48	29.61	37.01	45.14
2060	Private, Planned	35.40	7.5	3.44	4.70	5.57	5.68

2. WATERSHED B-B

Watershed B-B, situated in the northwest quadrant of Grandview, drains a total of 553 acres. The watershed extends southeasterly from a point south of Martha Truman Road and east of Prospect Avenue to its head water east of 2nd Street and north of Main Street.

Substantial areas of this watershed are presently undeveloped. Topographic constraints can be expected to limit the extent of future development. The largest single development in the watershed consists of Valley View Estates. The drainage system can be characterized as largely unimproved in the lower areas of the watershed, modifying to relatively short reaches of enclosed systems interrupted by unimproved open channels.

A total of 34 subareas and 37 discrete pipe, channel, or roadway culvert reaches were modelled for this watershed. Pertinent data on the watershed is as follows:

Drainage Area;	553.2 ac.
Watershed Hydraulic Length:	9,075 ft.
Percent of Hydraulic Length Improved:	18.4 percent
Maximum Elevation:	1,060 ft. m.s.l.
Minimum Elevation:	832 ft. m.s.l.
Composite S.C.S. Curve Number:	75.4

Table IV-12 indicates the specific hydraulic capacity of each reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-13.

Table IV-12

WATERSHED B-B, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	Unlined Channel	465	364	547	712	946
1010	Unlined Channel	102	62	108	141	182
1020	Unlined Channel	371	301	471	615	829
1030	Unlined Channel	414	282	459	605	818
1040	Unlined Channel	70	271	452	592	791
1050	Unlined Channel	99	52	97	143	283
1060	Detention Facility	116	29	70	128	256
1090	Detention Facility	32	24	117	179	271
1100	15" RCP	10	56	85	103	128
1110	Unlined Channel	36	56	85	105	129
1120	18" RCP	13	5	7	9	11
1130	42" RCP	103	40	61	76	92
1140	4'x2.5' RCB	70	32	49	61	74
1150	Unlined Channel	60	33	50	61	75
1170	Unlined Channel	31	24	36	44	53
1180	24" CMP	20	11	17	21	26
1190	Unlined Channel	53	55	87	108	132
1195	15" RCP	7	8	11	13	15
1200	5'x3' RCB	225	46	73	91	112
1220	Unlined Channel	86	42	67	84	102
1230	15" RCP	6	14	20	25	30
1240	Unlined Channel	110	223	352	448	559
1250	Unlined Channel	73	44	75	96	127
1260	4.5'x4' RCB	269	159	243	311	390
1270	Unlined Channel	179	156	240	310	388
1280	87"x63" CMPA	298	158	244	307	386
1290	36" CMP	69	34	52	66	81
1300	30" CMP	46	27	40	52	62
1310	73"x55" CMPA	215	123	186	236	299
1320	Unlined Channel	103	119	179	225	285
1330	Unlined Channel	83	103	158	199	247
1340	65"x40" CMPA	103	80	121	150	185
1350	58"x36" CMPA	74	63	97	121	149
1360	36"x22" CMPA	31	14	22	26	32
1370	50"x32" CMPA	52	45	70	88	108
1380	Unlined Channel	125	43	66	81	101
1390	3'x2' RCB	60	27	43	54	67

Table IV-13

WATERSHED B-B, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	4,685	0	(3)	165	0	4,850
2 yr.-5 yr.	5,230	0	(0)	0	600	5,830
5 yr.-10 yr.	1,610	0	(2)	85	685	2,380
10 yr.-25 yr.	1,450	0	(1)	50	860	2,360
>25 yr.	380	0	(1)	50	145	575
TOTAL	3,355	0	(7)	350	2,290	15,995

The model for watershed B-B includes a total of two detention facilities. Pertinent data on those facilities is summarized in the following table.

Table IV-14

WATERSHED B-B, EXISTING
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized 2 Yr. (ac-ft)	5 Yr. (ac-ft)	10 Yr. (ac-ft)	25 Yr. (ac-ft)
1060	Private, Recreational	132.63	8	2.83	5.45	7.68	8.95
1090	Private, Recreational	88.43	5	5.43	6.83	6.97	7.17

3. WATERSHED B-CD

Watershed B-CD, encompasses a total of 792 acres in the west-central portion of the City. There are 3 distinct outlets from this watershed, all situated along Grandview's westerly corporate limit. Of the total area, 447 acres are tributary to an open channel at a point south of Robinson Pike Road. An additional 231 acres are tributary to an existing 5'x2.5' RCB beneath Robinson Pike Road downstream of Main Street at approximately that same location.

This watershed is largely undeveloped. Significant existing development is generally limited to the area east of the Kansas City Southern Railroad, although some additional development has occurred in a relatively narrow strip generally centered on Main Street.

A total of 47 subareas and 52 discrete pipe, channel, culvert or detention reaches were modelled for this watershed. Pertinent data for the area tributary to the primary outlet is summarized below:

Drainage Area: 447.22 ac.
Watershed Hydraulic Length: 8,610 ft.

Percent of Length Improved:	33.3 percent
Maximum Elevation:	1,072 ft. m.s.l.
Minimum Elevation:	882 ft. m.s.l.
Composite S.C.S. Curve Number:	75.0

Table IV-15 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-16.

Table IV-15

WATERSHED B-CD, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	Unlined Channel	1,349	217	291	390	524
1010	10'x7' RCB	960	205	281	381	518
1020	Unlined Channel	102	41	69	91	117
1030	Unlined Channel	110	29	50	64	83
1040	Unlined Channel	24	15	25	32	42
1049	18" CMP	9	17	30	40	52
1050	Unlined Channel	148	134	210	287	403
1060	Unlined Channel	121	101	149	201	266
1070	Unlined Channel	53	88	142	185	239
1080	Unlined Channel	15	73	121	156	199
1090	30" RCP	48	53	84	107	135
1100	Unlined Channel	74	52	85	109	138
1110	Unlined Channel	43	30	49	64	82
1120	Unlined Channel	64	60	114	164	221
1130	30" CMP	29	60	116	161	223
1140	Unlined Channel	26	60	116	163	223
1150	Detention Facility	106	59	115	156	215
1160	Detention Facility	645	59	110	152	211
1170	15" CMP	6	10	16	21	25
1180	Unlined Channel	119	9	15	20	24
1190	15" CMP	6	8	13	16	20
1200	Unlined Channel	56	100	169	225	294
1210	24" RCP	28	92	151	197	262
1212	Unlined Channel	51	37	58	74	99
1214	Detention Facility	22	9	15	20	40
1220	Unlined Channel	51	15	29	40	53
1230	Detention Facility	79	11	21	30	41
1240	Unlined Channel	32	41	67	88	112
1250	30" RCP	58	20	32	41	51
1260	Detention Facility	41	5	9	11	14

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Table IV-15
(continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
2000	5'x2.5' RCB	105	182	288	385	506
2010	Unlined Channel	28	173	278	368	483
2020	10'x6' RCB	900	159	254	339	440
2030	Unlined Channel	48	157	260	347	448
2040	Unlined Channel	31	146	248	324	411
2050	Unlined Channel	39	122	194	247	311
2060	Unlined Channel	32	107	167	214	258
2070	42" CMP	54	84	128	167	208
2080	24" RCP	16	75	117	149	185
2100	Unlined Channel	212	79	124	158	194
2105	22"x14" CMPA	7	15	24	32	40
2110	22"x14" CMPA	7	60	90	110	135
2120	Unlined Channel	73	56	83	103	126
2130	24" RCP, 36" RCP	59	44	65	82	99
2140	Unlined Channel	129	45	66	83	101
2150	24" CMP	16	34	51	65	78
2160	24" CMP	16	22	32	41	49
3000	6'x5' RCB	450	116	162	212	280
3010	Unlined Channel	79	101	147	192	255
3020	Unlined Channel	15	46	85	116	155
3030	Unlined Channel	35	34	57	78	103
3040	2'x1.5' RCB	28	8	13	18	22

Table IV-16

WATERSHED B-CD, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	10,600	0	(11)	520	420	11,540
2 yr.-5 yr.	7,100	0	(1)	50	0	7,150
5 yr.-10 yr.	0	0	(0)	0	0	0
10 yr.-25 yr.	1,890	0	(0)	0	0	1,890
>25 yr.	3,250	0	(5)	300	0	3,550
TOTAL	22,840	0	(17)	870	420	24,130

The model for watershed B-CD includes a total of five detention facilities. Pertinent data on those facilities is summarized in the following table.

Table IV-17

WATERSHED B-CD, EXISTING
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized 2 Yr. (ac-ft)	5 Yr. (ac-ft)	10 Yr. (ac-ft)	25 Yr. (ac-ft)
1150	Private, Recreational	217.71	3	1.87	2.8	3	3
1160	Private, Recreational	205.52	36	6.75	10.38	12.99	16.22
1214	Unplanned	22.76	--	1.68	2.43	2.96	3.4
1230	Unplanned	32.99	--	1.50	2.38	2.73	3.75
1260	Private, Planned	9.06	3	0.74	1.02	1.21	1.43

4. WATERSHED B-E

Watershed B-E drains a total of 374 acres in the southwest corner of Grandview north of 143rd Street. This watershed has 3 outlets, all consisting of open channels at the westerly corporate limits. The largest of these three outlets drains a total of 164 acres.

This watershed is almost totally undeveloped. The only development of note consists of the Elks Lodge on Arlington Road.

A total of 17 subareas and 17 discrete pipe, channel, culvert or detention reaches were modelled for this watershed. Pertinent data for the area tributary to the largest of the three outlets is summarized below:

Drainage Area:	163.90 ac.
Watershed Hydraulic Length:	5,340 ft.
Percent of Length Improved:	6.6 percent
Maximum Elevation:	1,067 ft. m.s.l.
Minimum Elevation:	910 ft. m.s.l.
Composite S.C.S. Curve Number:	71.9

Table IV-18 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-19.

Table IV-18

WATERSHED B-E, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	Unlined Channel	20	118	199	266	353
1010	5'x7' Stone Culvert	349	103	165	215	279
1020	Unlined Channel	18	88	143	183	233
1030	Unlined Channel	27	62	105	137	177
1040	Unlined Channel	27	17	28	36	46
2000	Unlined Channel	116	46	83	114	144
2010	18" CMP	10	26	50	68	92
2015	Unlined Channel	20	22	41	57	77
2020	Detention Facility	143	21	39	53	71
2030	Detention Facility	67	19	35	46	60
3000	Unlined Channel	98	103	177	246	325
3010	Detention Facility	367	93	156	212	278
3020	Unlined Channel	162	94	166	216	277
3030	Unlined Channel	19	84	137	183	238
3040	Unlined Channel	6	70	119	157	201
3050	Roadway Overflow	--	8	14	18	22
3060	Roadway Overflow	--	44	73	95	121

Table IV-19

WATERSHED B-E, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	6,700	0	(3)	90	0	6,790
2 yr.-5 yr.	1,090	0	(0)	0	0	1,090
5 yr.-10 yr.	0	0	(0)	0	0	0
10 yr.-25 yr.	1,500	0	(0)	0	0	1,500
>25 yr.	0	0	(1)	30	0	30
TOTAL	9,290	0	(4)	120	0	9,410

The model for watershed B-E includes a total of three detention facilities. Pertinent data on those facilities is summarized in the following table.

Table IV-20

WATERSHED B-E, EXISTING
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized 2 Yr. (ac-ft)	5 Yr. (ac-ft)	10 Yr. (ac-ft)	25 Yr. (ac-ft)
2020	Private, Agricultural	29.84	1.5	0.40	0.63	0.76	0.91
2030	Private, Agricultural	23.19	0.9	0.37	0.56	0.70	0.83
3010	Private, Recreational	129.51	6	2.41	3.39	4.17	4.95

5. WATERSHED LN-A

Watershed LN-A, within the City limits, is generally bounded by the City limits on the north, Raytown Road on the east, Pittenger Road on the south, and Bennington Avenue on the west. Slightly over 540 acres of land in Kansas City, Missouri, extending as far north as Ruskin High School, are tributary to this watershed.

Within the City limits, the central portion of the watershed is fairly highly developed in residential subdivisions. However, substantial areas of undeveloped lands remain. Of the tributary area in Kansas City, approximately 150 acres are either lightly developed or undeveloped at present.

This watershed comprises the lower portion of the overall Little Blue North basin. Watersheds LN-BC, LN-DE, and LN-F are all tributary to this watershed.

A total of 34 subareas and 40 discrete channel, pipe, or roadway culvert reaches were modelled for this watershed. Pertinent data on the watershed (exclusive of LN-BC, LN-DE, and LN-F, but inclusive of directly tributary areas in Kansas City, Missouri) is as follows:

Drainage Area:	1,034 ac.
Watershed Hydraulic Length:	14,065 ft.*
Percent of Length Improved:	30 percent**
Maximum Elevation:	1,055 ft. m.s.l.
Minimum Elevation:	893 ft. m.s.l.
Composite S.C.S. Curve Number:	78.9

*8,265 feet in Grandview, Missouri
**Primarily in Kansas City, Missouri

When combined with Watersheds LN-F, LN-BC, and LN-DE, pertinent data for all the overall Little Blue North basin is as follows:

Drainage Area:	2,241 ac.
Watershed Hydraulic Length:	19,555 ft.
Percent of Length Improved:	42 percent

Maximum Elevation: 1,079 ft. m.s.l.
Minimum Elevation: 893 ft. m.s.l.
Composite S.C.S. Curve Number: 79.8

Table IV-21 indicates the specific hydraulic capacity of each modelled reach of the basin within Grandview relative to its current estimated demand (including flow contributions from tributary watersheds) at a variety of return periods. A summary elevation by type of facility and present level of service is presented in Table IV-22.

Table IV-21

WATERSHED LN-A, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	Two 17'-2"x11'-4" CMPA	3,511	1,430	2,132	2,747	3,507
1010	Unlined Channel	178	19	33	43	54
1020	Riprap Lined Channel	431	207	324	410	492
1030	24" RCP	32	5	8	11	13
1040	Unlined Channel	404	193	305	393	484
1050	Two 8'-7"x5'-11" CMPA	576	185	293	385	480
1060	Unlined Channel	368	190	302	393	493
1070	Unlined Channel	435	145	236	302	382
1090	Unlined Channel	736	1,369	2,043	2,635	3,373
1095	24" CMP	13	17	29	37	47
1100	Unlined Channel	376	1,377	2,045	2,621	3,385
1110	Unlined Channel	619	1,212	1,862	2,380	2,955
1120	12'x6' RCB, 14'x6' RCB	1,758	1,216	1,858	2,363	3,015
1130	30" RCP	42	15	25	33	42
1140	Unlined Channel	1,029	1,213	1,865	2,379	3,032
1150	18" RCP	14	11	18	22	27
1159	Unlined Channel	310	59	90	112	138
1160	48" RCP	99	59	90	113	139
1170	42" RCP	142	53	80	100	125
1180	36" RCP	106	41	63	78	96
1190	24" RCP	24	11	18	22	28
1200	30" RCP	69	27	39	49	59
1210	24" RCP	37	16	24	30	36
1220	Unlined Channel	975	1,212	1,861	2,380	2,981
1230	30" RCP	41	23	34	43	52
1240	24" RCP	39	14	21	26	32
1241	24" RCP	19	14	21	25	31
1250	Unlined Channel	331	152	228	276	341
1251	Unlined Channel	255	153	228	276	335
1260	54" RCP	184	141	211	260	320
1270	48" RCP	152	137	209	258	317

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Table IV-21
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1280	48" RCP	187	114	170	210	257
1290	Unlined Channel	1,024	1,160	1,788	2,265	2,818
1300	47'x6.5' Bridge	3,062	1,176	1,785	2,266	2,825
1310	Unlined Channel	806	1,177	1,785	2,263	2,834
1320	Unlined Channel	404	603	919	1,162	1,426
1330	Unlined Channel	557	619	939	1,183	1,459
1340	Unlined Channel	395	849	1,315	1,676	2,070
1350	Unlined Channel	260	889	1,356	1,701	2,121

Table IV-22

WATERSHED LN-A, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	9,645	0	(1)	30	0	9,675
2 yr.-5 yr.	800	0	(1)	40	790	1,630
5 yr.-10 yr.	2,170	0	(0)	0	505	2,675
10 yr.-25 yr.	970	670	(1)	40	470	2,150
>25 yr.	2,700	0	(4)	460	1,815	4,975
TOTAL	16,285	670	(7)	570	3,580	21,105

6. WATERSHED LN-BC

Watershed LN-BC, the most northwesterly segment of the overall Little Blue North drainage area, drains a total of 566 acres, including slightly over 150 acres north of Martha Truman Road and the City limit. The watershed extends northeasterly from its headwater at 7th and Main, eventually discharging to Watershed LN-A at Line 1350, situated southeast of the intersection of 120th St. Terrace and Bennington.

Significant features in the watershed include U.S. Highway No. 71 and the Truman Corners shopping center. Downstream of Highway 71 and within the City limits, the watershed is roughly half developed, with existing development limited primarily to the Cross Gates subdivision. Sizable tracts of developable land also remain upstream of Truman Corners.

A total of 43 subareas and 46 discrete pipe, channel, or roadway culvert reaches were modelled for this watershed. Pertinent data on the watershed is as follows:

Drainage Area:	566 ac.
Watershed Hydraulic Length:	11,240 ft.
Percent of Hydraulic Length Improved:	63 percent
Maximum Elevation:	1,079 ft. m.s.l.

Minimum Elevation: 944 ft. m.s.l.
Composite S.C.S. Curve Number: 82

Table IV-23 indicates the specific hydraulic capacity of each reach relative to its current estimated demand at a variety of return periods. A summary elevation by type of facility and present level of service is presented in Table IV-24.

Table IV-23

WATERSHED LN-BC, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
4000	Unlined Channel	547	642	1,001	1,253	1,574
4010	21" CMP	4	11	16	20	25
4020	P.C.C. Lined Channel	2,700	661	1,028	1,266	1,543
4030	54" CMP	136	213	320	401	492
4040	54" CMP	136	200	294	367	446
4050	54" CMP	136	115	171	212	262
4060	P.C.C. Lined Channel	2,340	487	778	957	1,159
4065	P.C.C. Lined Channel	1,785	489	777	956	1,157
4070	48" CMP	103	99	142	172	216
4080	48" CMP	81*	76	109	135	167
4090	48" RCP	176	74	111	136	174
4100	Unlined Channel	139	401	634	778	935
4110	4'x4' RCB	156	48	67	80	96
4120	4'x2.5' RCB	70	30	40	47	55
4130	6'x6' RCB	540	312	495	595	728
4140	6'x6' RCB	540	309	489	597	721
4142	72" RCP	424	293	465	572	692
4144	36" RCP	79	120	169	205	245
4146	24" RCP	27	36	53	65	80
4148	27" RCP	37	56	80	98	118
4150	27" RCP	37	41	60	73	90
4152	30" RCP	60	35	51	64	78
4154	24" RCP	23	14	20	26	29
4159	54" RCP	238	171	298	370	444
4160	54" RCP	216	151	274	344	412
4170	Unlined Channel	107	0	52	67	85
4180	Unlined Channel	536	148	222	275	328
4190	Unlined Channel	276	17	27	33	41
4200	36" RCP	56	15	23	29	36
4210	36" RCP	56	11	18	22	27
4220	48" CMP	106	124	182	225	267

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Table IV-23
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
4230	Unlined Channel	200	123	179	228	270
4240	P.C.C. Lined Channel	228	113	165	203	243
4250	72"x44" CMPA	102	90	129	159	192
4260	72"x44" CMPA	102	78	115	142	174
4270	60" CMP	125	67	102	124	153
4275	36" RCP	30	12	18	23	29
4276	30" CMP	19	7	10	12	15
4280	54" CMP	111	57	85	106	130
4281	36" CMP	38	4	5	7	8
4290	48" CMP	81	53	79	100	119
4295	48" CMP	73	46	68	86	102
4300	48" CMP	73	41	61	78	91
4305	42" CMP	55	30	44	55	65
4310	36" CMP	29	26	39	47	57
4320	30" CMP	21	15	21	26	31

*Line 4080 theoretical capacity; line is totally ineffective at present.

Table IV-24

WATERSHED LN-BC, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	2,850	0	(1)	50	3,920	6,820
2 yr.-5 yr.	0	0	(0)	0	3,375	3,375
5 yr.-10 yr.	350	0	(2)	440	1,835	2,625
10 yr.-25 yr.	0	400	(0)	0	1,880	2,280
>25 yr.	2,000	1,150	(2)	270	710	4,130
TOTAL	5,200	1,550	(5)	760	11,720	19,230

7. WATERSHED LN-DE

Watershed LN-DE, draining a total of 360 acres, extends northeasterly from its headwater at 9th and Main, eventually discharging to Watershed LN-A at Line 1350, situated midway between U.S. Highway 71 and Food Lane north of 123rd St. Terrace.

A significant feature in this watershed is the presence of U.S. Highway 71. Downstream of Highway 71, development has generally been limited to areas south of 125th Street. The upper reaches of the watershed, encompassing portions of the downtown business district, are highly developed, although undeveloped tracts remain west of Highway 71.

A total of 42 subareas and 44 discrete pipe or channel reaches were modelled for this watershed. Pertinent data on the watershed is as follows:

Drainage Area:	360 ac.
Watershed Hydraulic Length:	10,480 ft.
Percent of Length Improved:	54 percent
Maximum Elevation:	1,079 ft. m.s.l.
Minimum Elevation:	944 ft. m.s.l.
Composite S.C.S. Curve Number:	79.6

Table IV-25 indicates the specific hydraulic capacity of each reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-26.

Table IV-25

WATERSHED LN-DE, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
3000	Unlined Channel	139	317	491	617	735
3010	Unlined Channel	193	323	509	639	746
3020	Unlined Channel	64	24	40	52	65
3025	24" CMP	29	8	13	16	20
3030	Unlined Channel	191	325	505	633	716
3040	Unlined Channel	135	351	532	649	708
3045	Unlined Channel	280	358	515	645	686
3050	78" CMP	296	368	548	633	679
3055	24" CMP	6	9	14	19	24
3060	112"x75" CMPA	178	75	109	133	160
3065	71"x47" CMPA	67	19	27	33	39
3070	Unlined Channel	297	56	82	99	120
3080	42" CMP	98	44	61	73	87
3085	36" CMP	65	20	28	34	40
3086	30" CMP	37	13	18	22	26
3090	102" CMP	503	283	420	494	502
3100	8'x4' RCB	480	272	404	477	484
3110	53"x34" RCPHE	48	25	34	41	49
3115	2-27" RCP	42	20	27	34	38
3120	8'x4' RCB	371	244	361	446	543
3125	6'x4' RCB	225	190	285	349	429
3130	54" CMP	157	55	80	98	116
3140	48" CMP	99	50	72	87	105
3145	18" RCP	18	10	14	17	21

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Table IV-25
(continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
3150	3'x2' RCB	83	37	54	65	79
3160	3'x2' RCB	84	27	40	48	59
3170	Unlined Channel	2,429	189	285	349	433
3180	24" RCP	31	13	20	25	31
3200	72"x44" CMPA	164	171	256	309	382
3210	36" CMP	17	9	13	16	20
3215	36" CMP	27	3	5	6	8
3220	21" RCP	29	16	25	34	40
3225	18" RCP	21	11	17	24	28
3230	54" RCP	193	136	202	243	299
3235	30" CMP	23	13	19	23	28
3240	42" RCP	135	115	171	208	255
3250	24" RCP	10	23	34	42	50
3251	18" RCP	8	14	22	26	31
3260	42" RCP	135	80	119	146	179
3270	36" RCP	67	27	40	49	61
3280	30" RCP	65	23	33	39	49
3290	36" RCP	82	45	67	84	100
3300	36" RCP	60	36	53	66	77
3310	27" RCP	44	18	26	31	37

Table IV-26

WATERSHED LN-DE, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	4,800	0	(1)	80	1,210	6,090
2 yr.-5 yr.	0	0	(0)	0	1,060	1,060
5 yr.-10 yr.	0	0	(0)	0	2,405	2,405
10 yr.-25 yr.	1,000	0	(0)	0	1,865	2,865
>25 yr.	950	0	(3)	340	2,600	3,890
TOTAL	6,750	0	(4)	420	9,140	16,310

8. WATERSHED LN-F

Watershed LN-F is generally bounded by Sycamore Avenue on the east, 127th Street on the south, Bennington Avenue on the west, and Pittenger Road on the north. A total of 281 acres are included in this watershed, which is tributary to Line No. 1100 of Watershed LN-A.

The upper portion of the watershed is largely developed, primarily in single family residences. A significant feature is Mapleview Park, situated at the southeast corner of Winchester Avenue and 125th Street. The lower portion of the watershed is largely undeveloped.

A total of 26 subareas and 29 discrete pipe, channel, or culvert reaches were modelled for this watershed. Pertinent data on the watershed is as follows:

Drainage Area:	281 ac.
Watershed Hydraulic Length:	6,855 ft.
Percent of Length Improved:	35 percent
Maximum Elevation:	1,056 ft. m.s.l.
Minimum Elevation:	894 ft. m.s.l.
Composite S.C.S. Curve Number:	78.1

Table IV-27 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-28.

Table IV-27

WATERSHED LN-F, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
2000	Unlined Channel	771	311	496	634	762
2010	Unlined Channel	969	45	73	93	115
2015	Unlined Channel	183	29	44	55	67
2020	30" RCP	45	27	41	51	61
2030	30" RCP	31	17	25	33	39
2040	Unlined Channel	594	267	421	534	658
2050	Unlined Channel	1,208	250	374	482	595
2060	Unlined Channel	116	14	22	27	33
2080	Unlined Channel	875	211	333	431	523
2090	54" CMP	155	216	338	440	529
2100	Unlined Channel	528	216	343	438	536
2110	Unlined Channel	594	202	312	396	492
2120	Unlined Channel	637	64	97	121	146
2130	42" CMP	102	60	89	110	132
2140	42" CMP	62	24	36	44	54
2150	30" CMP	33	10	15	18	23
2155	24" CMP	41	8	11	14	18
2160	36" CMP	75	37	54	66	78
2170	30" CMP	49	23	34	41	49
2175	24" CMP	29	21	33	38	46
2180	42" CMP	80	118	184	233	288

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Table IV-27
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
2190	Unlined Channel	632	121	185	233	292
2200	72" CMP	371	102	156	195	241
2210	60" CMP	104	93	141	177	219
2220	30" CMP	42	16	23	29	35
2230	48" CMP	120	63	97	122	151
2240	24" CMP	11	15	22	29	34
2250	42" CMP	86	39	61	77	97
2260	36" CMP	65	32	50	62	77

Table IV-28

WATERSHED LN-F, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	0	0	(2)	70	380	450
2 yr.-5 yr.	0	0	(0)	0	670	670
5 yr.-10 yr.	0	0	(0)	0	975	975
10 yr.-25 yr.	1,600	0	(0)	0	1,650	3,250
>25 yr.	5,305	0	(0)	0	1,545	6,850
TOTAL	6,905	0	(2)	70	5,220	12,195

9. WATERSHED LS-AB

Watershed LS-AB is generally bounded by Raytown Road on the east, Highgrove Road on the south, Highway 71 on the west, and 127th Street on the north. A total of 496 acres are included in this watershed, with 419 acres tributary to a 10'-2"x14'-11" CMPA beneath Raytown Road immediately north of Highgrove Road, and 76 acres tributary to a 72" CMP beneath Raytown Road further to the north.

The watershed is highly developed, with little potential for significant additional development. Open areas situated east of the Highgrove Estates subdivision were acquired by the Corps of Engineers for the Longview Lake project.

A total of 56 subareas and 65 discrete pipe, channel or culvert reaches were modelled for this watershed. Pertinent data for the area tributary to the primary outlet are summarized below:

Drainage Area:	419 ac.
Watershed Hydraulic Length:	9,080 ft.
Percent of Length Improved:	69 percent
Maximum Elevation:	1,063 ft. m.s.l.
Minimum Elevation:	894 ft. m.s.l.
Composite S.C.S. Curve Number:	82

Table IV-29 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-30.

Table IV-29

WATERSHED LS-AB, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	10'-2"x14'-11" CMPA	1,272	536	821	1,018	1,229
1010	Unlined Channel	161	14	24	31	39
1020	30" CMP	33	19	29	36	45
1025	Unlined Channel	908	512	781	968	1,169
1030	Unlined Channel	184	516	779	965	1,165
1035	P.C.C. Lined Channel	1,733	469	704	858	1,020
1039	Unlined Channel	145	28	41	52	63
1040	36" RCP	73	27	40	50	61
1050	24" CMP	20	19	30	38	48
1060	2-7'x4', 2-7.5'x4' RCB	1,240	453	682	832	983
1070	21" CMP	11	8	14	17	21
1080	P.C.C. Lined Channel	1,733	431	649	791	935
1090	24" CMP	21	13	20	26	31
1100	21" CMP	14	8	13	16	20
1110	P.C.C. Lined Channel	1,463	411	620	755	892
1120	24" CMP	17	17	26	31	39
1130	21" RCP	17	13	21	25	31
1140	8.5'x5.5' RCB, 54" RCP	759	388	583	704	832
1150	P.C.C. Lined Channel	1,755	385	579	700	828
1160	30" CMP	33	12	18	22	26
1170	21" RCP	29	13	19	25	29
1180	P.C.C. Lined Channel	1,279	346	522	627	751
1181	30" CMP	40	11	16	20	24
1182	P.C.C. Lined Channel	603	335	500	600	734
1183	24" CMP	16	9	14	17	21
1190	42" RCP	94	51	76	97	116
1195	42" RCP	92	49	74	95	114
1200	30" RCP	57	25	37	46	56
1210	24" RCP	40	22	33	42	49
1220	8'x4' RCB, 8'x5' RCB	701	273	408	497	590
1230	P.C.C. Lined Channel	630	270	403	493	578
1240	7'x4' RCB, 48" RCP	370	251	375	459	543

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Table IV-29
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1250	P.C.C. Lined Channel	578	250	373	458	534
1260	30" RCP	48	40	61	74	88
1270	P.C.C. Lined Channel	46	25	38	47	56
1274	Unlined Channel	133	14	21	25	31
1278	24" RCP	18	8	12	14	17
1280	15" CMP	6	8	12	14	17
1290	P.C.C. Lined Channel	413	201	297	363	438
1300	15" RCP	11	8	13	16	19
1310	30" CMP	33	25	39	47	59
1320	24" CMP	18	17	28	34	42
1330	7.5'x4' RCB	376	162	239	293	358
1340	Unlined Channel	295	163	239	293	359
1350	24" RCP	23	14	21	26	32
1360	48" RCP, 48" CMP	262	125	180	221	272
1370	21" RCP	17	10	15	18	23
1380	Unlined Channel	572	115	166	204	252
1390	48" CMP	141	102	145	179	217
1400	36" CMP	35	20	29	34	42
1430	Unlined Channel	884	79	114	139	171
1440	42" CMP	80	68	98	120	147
1450	36" CMP	60	60	85	103	125
1460	30" CMP	40	29	44	50	63
1470	30" CMP	40	23	33	39	48
1480	30" CMP	40	19	27	33	41
2000	72" CMP	330	2	137	172	213
2010	Unlined Channel	88	7	12	15	19
2020	Unlined Channel	88	2	3	3	4
2030	Unlined Channel	114	63	127	159	199
2040	Unlined Channel	671	0	32	42	53
2060	Unlined Channel	206	50	80	100	124
2070	36" CMP	68	38	59	72	90
2080	21" CMP	11	7	11	14	17
2090	21" CMP	13	12	17	21	25

Table IV-30

WATERSHED LS-AB, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	900	0	(0)	0	150	1,050
2 yr.-5 yr.	650	0	(0)	0	3,185	3,835
5 yr.-10 yr.	580	420	(1)	40	1,955	2,995
10 yr.-25 yr.	600	1,290	(2)	110	915	2,915
>25 yr.	5,700	2,640	(5)	555	775	9,670
TOTAL	8,430	4,350	(8)	705	6,980	20,465

10. WATERSHED LS-C

Watershed LS-C encompasses a total of 131 acres draining to a series of outlets directly tributary to the Little Blue River between Byars Road and Merrywood Lane in the vicinity of 140th Street.

This watershed is largely developed, with remaining developable lands generally bounded by Byars Road and Belmont between 137th Street and 140th Street.

A total of 34 subareas and 40 discrete pipe and channel reaches were modelled for this watershed. Pertinent data for the most significant of the various basin outlets is summarized below:

Drainage Area:	50.9 ac.
Watershed Hydraulic Length:	3,560 ft.
Percent of Length Improved:	82 percent
Maximum Elevation:	1,010 ft. m.s.l.
Minimum Elevation:	925 ft. m.s.l.
Composite S.C.S. Curve Number:	81.9

Table IV-31 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-32.

Table IV-31

WATERSHED LS-C, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	72"x44" CMPA	94	72	107	129	159
1010	72"x44" CMPA	84	63	94	114	139
1020	48" CMP	120	60	92	111	135
1030	42" CMP	98	59	90	109	134
1040	18" CMP	8	6	9	11	14
1050	42" CMP	98	53	81	98	121
1060	24" RCP	28	54	80	98	121
1070	Unlined Channel	79	50	76	93	114
1074	36" CMP	53	34	52	64	79
1078	21" CMP	14	8	12	16	20
1080	18" CMP	8	5	7	9	11
1090	36" RCP	77	26	39	48	60
1100	36" RCP	60	21	32	38	49
1110	30" CMP	28	15	23	28	36
1120	18" CMP	12	10	15	18	22
1130	18" CMP	10	4	5	7	9
1140	18" CMP	10	5	7	9	12
2000	50"x31" CMPA	30	25	37	46	56
2010	43"x27" CMPA	23	20	30	37	45
2020	24" RCP	27	16	24	31	37
2025	Unlined Channel	47	17	24	30	36
2030	18" CMP	7	16	23	29	35
2040	18" CMP	6	8	12	15	19
2050	15" CMP	4	7	11	14	17
3000	24" RCP	20	10	15	19	23
4000	43"x27" CMPA	35	24	37	47	58
4010	29"x18" CMPA	7	7	10	13	15
4020	18" CMP	12	3	5	6	8
4030	36"x22" CMPA	33	15	23	29	37
5000	29"x18" CMPA	10	45	74	95	121
5010	Unlined Channel	15	41	67	88	110
5020	Unlined Channel	9	9	13	16	20
5040	15" CMP	5	5	7	9	11
5050	Unlined Channel	19	33	51	63	80
5060	Unlined Channel	23	30	47	59	75
5070	2-24" CMP	36	24	36	44	55
5080	24" CMP	13	14	20	25	31
5090	15" CMP	7	3	5	6	8
5100	24" CMP	13	11	16	19	24
5110	18" CMP	10	6	10	12	14

GRP4.SMP

Table IV-32

WATERSHED LS-C, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	1,810	0	(0)	0	385	2,195
2 yr.-5 yr.	620	0	(0)	0	1,380	2,000
5 yr.-10 yr.	500	0	(0)	0	725	1,225
10 yr.-25 yr.	0	0	(0)	0	1,415	1,415
>25 yr.	120	0	(0)	0	1,150	1,270
TOTAL	3,050	0	(0)	0	5,055	8,105

11. WATERSHED LS-D

Watershed LS-D drains a total of 414 acres tributary to a double 8'x6' RCB beneath Byars Road approximately 350 feet north of the Little Blue River.

This watershed is highly developed. Previously platted areas south of Highgrove Road are currently under residential development, and are considered as developed in this analysis. Remaining significant parcels subject to development are situated at the upstream end of the watershed, lying north and south of Main Street west of Beacon.

A total of 72 subareas and 77 discrete pipe, channel, or culvert reaches were modelled for this watershed. Pertinent data for the watershed is as follows:

Drainage Area:	414.07 ac.
Watershed Hydraulic Length:	9,300 ft.
Percent of Length Improved:	66 percent
Maximum Elevation:	1,063 ft. m.s.l.
Minimum Elevation:	907 ft. m.s.l.
Composite S.C.S. Curve Number:	80.9

Table IV-33 indicates the specific hydraulic capacity of each reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-34.

Table IV-33

WATERSHED LS-D, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	2-8'x6' RCB	1,145	506	758	916	1,043
1004	Unlined Channel	926	498	745	890	1,038
1008	Unlined Channel	926	503	748	906	1,034
1012	Unlined Channel	912	488	715	894	1,043
1015	36" RCP	30	24	37	45	54
1018	30" RCP	30	18	28	33	39
1020	30" RCP	30	13	19	24	30
1025	18" RCP	18	13	20	24	29
1030	18" RCP	7	6	10	11	15
1040	2-8'x4' RCB, 1-10'x5' RCB	823	448	665	820	967
1050	P.C.C. Lined Channel	780	441	656	822	968
1060	36" CMP	50	34	52	63	78
1064	30" CMP	28	21	32	39	48
1068	21" CMP	15	12	19	23	27
1070	2-7.5'x4' RCB, 1-10'x4' RCB	985	417	612	744	877
1075	15" RCP	9	14	20	24	30
1080	P.C.C. Lined Channel	540	194	289	360	442
1090	7'-5' RCB	336	192	288	357	438
1092	30" CMP	33	13	21	25	31
1094	27" CMP	27	9	14	17	21
1096	18" CMP	10	7	12	13	15
1100	P.C.C. Lined Channel	208	174	266	330	405
1110	5'-4"x4' RCB	186	170	256	320	389
1115	P.C.C. Lined Channel	328	167	253	313	383
1120	Unlined Channel	231	163	255	317	386
1140	Unlined Channel	59	149	225	281	340
1150	Unlined Channel	79	59	84	103	125
1160	42" RCP	105	33	46	55	66
1170	30" RCP	54	20	28	34	42
1180	Unlined Channel	162	95	144	176	216
1190	42" RCP	103	87	131	162	197
1200	43"x27" CMPA	37	6	9	12	14
1220	36" RCP	81	77	116	142	175
1230	36" RCP	106	77	116	141	174
1234	36" RCP	106	64	94	117	143
1238	36" RCP	106	50	75	93	114
1242	36" RCP	75	46	70	86	106

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Table IV-33
(continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1246	18" RCP	5	10	17	22	28
1250	30" RCP	65	36	53	66	79
1254	27" RCP	59	31	46	56	67
1258	21" RCP	12	6	10	13	16
1262	24" RCP	36	22	32	40	46
1266	24" RCP	29	21	30	37	44
1270	18" RCP	14	18	24	28	33
1280	P.C.C. Lined Channel	427	207	304	367	424
1290	30" CMP	40	25	36	45	56
1300	18" CMP	11	19	28	34	45
1310	15" CMP	7	13	18	21	27
1320	73"x55" CMPA	196	175	258	307	341
1325	18" CMP	12	5	7	9	11
1330	P.C.C. Lined Channel	223	174	253	303	339
1340	36" CMP, 24" CMP	37	28	44	55	68
1350	30" CMP, 18" CMP	52	19	30	38	47
1360	P.C.C. Lined Channel	309	147	217	253	273
1370	72"x44" CMPA	117	130	190	226	232
1380	54" CMP	111	124	181	218	220
1390	54" CMP	111	120	179	211	215
1400	54" CMP	111	115	174	216	265
1410	54" CMP	111	110	168	209	257
1420	48" CMP, 58"x36" CMPA	161	107	160	200	249
1425	48" CMP, 43"x27" CMPA	118	76	113	139	172
1430	58"x36" CMPA	77	28	44	56	70
1440	36" CMP	64	20	31	39	49
1450	36" CMP	51	16	24	30	38
1455	3'x2' RCB, 24" RCP	62	15	24	30	38
1460	P.C.C. Lined Channel	135	76	114	138	171
1470	42" RCP	69	74	108	136	169
1480	Unlined Channel	210	71	106	131	161
1485	Unlined Channel	22	57	83	102	124
1490	36" RCP	49	48	70	86	106
1495	30" CMP	28	39	57	70	85
1500	Unlined Channel	198	39	56	68	83
1510	50"x31" CMPA	60	35	50	61	74
1515	50"x31" CMPA	60	34	49	61	74
1518	50"x31" CMPA	59	34	49	60	73
1520	24" CMP	14	16	23	29	35
1530	36" RCP	50	18	25	31	36

Table IV-34

WATERSHED LS-D, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	780	0	(1)	140	2,080	3,000
2 yr.-5 yr.	1,570	730	(2)	240	2,700	5,240
5 yr.-10 yr.	650	690	(4)	230	1,990	3,560
10 yr.-25 yr.	2,110	120	(1)	50	685	2,965
>25 yr.	720	1,900	(4)	190	2,050	4,860
TOTAL	5,830	3,440	(12)	850	9,505	19,625

12. WATERSHED LS-EF

Watershed LS-EF drains a total of 263 acres tributary to a 52-foot wide by 10-foot high bridge opening beneath 140th Street east of 71 Highway. In addition to this directly tributary area, Watershed LS-HIJK discharges to Line No. 1030 of Watershed LS-EF.

This watershed is highly developed; future development is expected to consist largely of in-fill development. An exception is the present undeveloped tract adjacent to King Louie, west of 71 Highway and south of 135th Street. Commercial and industrial development is linear in nature, extending along the Highway 71 frontage and along Main Street west of Highway 71.

A total of 37 subareas and 39 discrete pipe, channel, or culvert reaches were modelled for this watershed. Pertinent data on the watershed (exclusive of Watershed LS-HIJK) is as follows:

Drainage Area:	263.09 ac.
Watershed Hydraulic Length:	8,180 ft.
Percent of Length Improved:	33 percent
Maximum Elevation:	1,071 ft. m.s.l.
Minimum Elevation:	926 ft. m.s.l.
Composite S.C.S. Curve Number:	82.0

When combined with Watershed LS-HIJK, pertinent data for all areas tributary to the 140th Street bridge is summarized below:

Drainage Area:	757.81 ac.
Watershed Hydraulic Length:	10,440 ft.
Percent of Length Improved:	69 percent
Maximum Elevation:	1,077 ft. m.s.l.
Minimum Elevation:	926 ft. m.s.l.
Composite S.C.S. Curve Number:	81.2

Table IV-35 indicates the specific hydraulic capacity of each modelled reach of the basin relative to its current estimated demand (including contributions from Watershed LS-HIJK) at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-36.

Table IV-35

WATERSHED LS-EF, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	52'x10' Bridge Opening	3,130	725	1,132	1,430	1,688
1010	30" RCP	41	8	12	15	18
1020	Unlined Channel	719	742	1,129	1,433	1,700
1030	Unlined Channel	408	440	703	898	1,007
1040	30" RCP	18	23	36	42	52
1050	14'x4' RCB	624	313	471	576	707
1055	P.C.C. Lined Channel	971	309	465	568	702
1060	Unlined Channel	502	311	470	571	712
1065	P.C.C. Lined Channel	887	283	425	537	671
1070	10'x4' RCB	453	280	423	530	661
1072	24" RCP	28	24	34	41	48
1075	54" RCP	205	263	387	492	613
1080	54" RCP	186	265	378	483	604
1085	42" RCP	105	227	349	439	546
1090	36" RCP	64	36	47	60	76
1100	3'x2' RCB	49	11	19	26	34
1110	Unlined Channel	253	10	16	20	24
1120	24" RCP	28	6	9	12	14
1130	Unlined Channel	609	222	342	425	528
1140	46"x31" CMPA	56	220	336	412	512
1150	Unlined Channel	602	210	318	395	485
1160	49"x33" CMPA	52	209	317	391	483
1170	24" CMP	9	22	33	41	50
1180	5'x4' RCB	300	178	268	330	406
1190	3'x2' RCB	22	29	45	57	70
1192	Unlined Channel	20	19	32	38	50
1194	15" CMP	7	11	18	23	29
1200	Unlined Channel	415	139	208	259	317
1210	4'x2.5' RCB	92	92	138	173	215
1220	24" RCP	34	85	129	160	199
1230	18" CMP	9	34	47	58	70
1240	24" CMP	24	53	81	102	127
1250	24" CMP	18	47	70	91	113
1260	18" CMP	8	23	34	44	54
1270	15" CMP	8	5	7	9	11

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Table IV-35
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1280	Unlined Channel	69	50	72	88	106
1290	30" RCP	74	37	53	63	76
1300	18" RCP	15	20	28	34	41
1310	15" RCP	9	18	25	31	37

Table IV-36

WATERSHED LS-EF, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	1,600	0	(5)	360	3,210	5,170
2 yr.-5 yr.	2,160	0	(1)	60	50	2,270
5 yr.-10 yr.	1,020	0	(1)	210	540	1,770
10 yr.-25 yr.	0	0	(1)	50	360	410
>25 yr.	2,160	440	(2)	90	205	2,895
TOTAL	6,940	440	(10)	770	4,365	12,515

13. WATERSHED LS-G

Watershed LS-G consists of a series of relatively small watershed directly tributary to the Little Blue River between U.S. Highway 71 and the easterly corporate limits of Grandview. The existing conditions model includes 9 points of discharge to the Little Blue.

This watershed is largely undeveloped. Exceptions include those areas immediately adjacent to U.S. Highway 71, and the River Oaks subdivision. A significant feature is the River Oaks golf course, which will tend to limit future conversion to impervious surfaces in the central third of this watershed.

A total of 35 subareas and 37 discrete pipe, channel, or culvert reaches were modelled for this watershed. The total tributary area included in the existing system model is 462.8 acres.

Table IV-37 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-38.

Table IV-37

WATERSHED LS-G, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	Unlined Channel	218	249	298	337	385
1010	Unlined Channel	260	231	249	271	288
1020	Unlined Channel	170	37	68	91	119
1030	Unlined Channel	170	29	53	71	93
1100	18" CMP	8	156	154	159	156
1103	Unlined Channel	114	150	150	151	152
1105	1-16", 1-18" CMP	16	32	36	47	63
1110	Unlined Channel	161	15	27	36	47
1115	15" CMP	5	26	52	78	113
1120	Unlined Channel	28	25	53	79	117
1130	Detention Facility	99	24	50	74	105
1140	Detention Facility	64	37	60	83	120
1150	Unlined Channel	71	32	58	77	100
1200	12" CMP	3	29	54	75	98
1205	Unlined Channel	59	27	52	74	98
1210	Detention Facility	99	25	45	62	84
1220	Unlined Channel	29	28	48	65	86
1300	Unlined Channel	28	89	90	91	91
1310	24" CMP	18	11	20	27	35
1315	Unlined Channel	28	26	36	48	61
1320	Unlined Channel	28	19	26	33	44
1330	Unlined Channel	113	14	25	34	44
1400	30" CMP	41	20	31	39	46
1410	18" CMP	17	15	22	27	32
1500	24" CMP	26	17	25	31	38
1505	24" CMP	26	13	19	25	30
1510	18" CMP	15	10	16	19	23
1600	30" CMP	23	24	37	47	59
1610	30" CMP	23	12	19	24	30
1620	30" CMP	46	8	11	14	17
1650	Unlined Channel	153	14	24	33	43
1655	36"x22" CMPA	14	6	10	13	17
1700	2-30" RCP	75	59	91	112	139
1710	Unlined Channel	77	54	82	101	125
1720	36" RCP	77	50	79	99	123
1725	3'x2' RCB	69	45	71	91	113
1730	3'x2' RCB	69	37	58	74	92

GRP4.SMP

Table IV-38

WATERSHED LS-G, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	1,900	0	(4)	120	60	2,080
2 yr.-5 yr.	2,560	0	(4)	370	310	3,240
5 yr.-10 yr.	2,320	0	(1)	60	560	2,940
10 yr.-25 yr.	0	0	(1)	80	630	710
>25 yr.	3,120	0	(0)	0	480	3,600
TOTAL	9,900	0	(10)	630	2,040	12,570

The model for watershed LS-G includes a total of three detention facilities. Pertinent data on those facilities is summarized in the following table.

Table IV-39

WATERSHED LS-G, EXISTING
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized 2 Yr. (ac-ft)	5 Yr. (ac-ft)	10 Yr. (ac-ft)	25 Yr. (ac-ft)
1130	Private, Agricultural	53.71	2.2	0.82	1.36	1.78	2.09
1140	Private, Agricultural	47.89	1.0	0.61	0.92	0.93	0.95
1210	Private, Agricultural	41.87	1.8	0.70	1.03	1.20	1.54

14. WATERSHED LS-HIJK

Watershed LS-HIJK drains a total of 495 acres tributary to a 12'x6' RCB beneath Highway 71 at 139th Street. This watershed is tributary to Line 1030 of Watershed LS-EF.

Watershed LS-HIJK is highly developed. Significant areas remaining to be developed are clustered around the John S. Anderson Park, and adjacent to the existing K-Mart and King Louie developments west of Highway 71 and north of 139th Street.

A total of 60 subareas and 65 discrete pipe, channel, culvert or detention reaches were modelled for this watershed. Pertinent data on the watershed is as follows:

Drainage Area:	494.72 ac.
Watershed Hydraulic Length:	8,840 ft.
Percent of Length Improved:	82 percent
Maximum Elevation:	1,077 ft. m.s.l.

Minimum Elevation: 938 ft. m.s.l.
Composite S.C.S. Curve Number: 80.7

Table IV-40 indicates the specific hydraulic capacity of each reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-41.

Table IV-40

WATERSHED LS-HIJK EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
2000	12'x6' RCB	939	448	700	902	1,000
2010	12'x6' RCB	922	433	678	876	1,112
2011	15" CMP	2	7	10	11	15
2020	P.C.C. Lined Channel	1,800	427	669	867	1,099
2021	36" RCP	52	21	28	33	38
2025	15" CMP	7	15	22	27	33
2030	14'x6' RCB	1,210	400	635	825	1,051
2040	P.C.C. Lined Channel	1,800	399	633	824	1,051
2050	Unlined Channel	2,121	49	69	66	83
2060	60" RCP	230	39	52	44	55
2065	42" RCP	31	11	20	12	17
2070	42" RCP	144	21	32	40	50
2080	Unlined Channel	750	21	33	40	52
2085	18" RCP	15	2	3	4	5
2090	Detention Facility	74	16	24	30	36
2100	36" CMP	35	31	48	60	73
2101	24" CMP	6	14	21	26	32
2105	30" CMP	30	18	26	34	39
2110	P.C.C. Lined Channel	3,060	310	500	681	878
2120	2-6'x4', 1-8'x4' RCB	1,155	302	495	672	868
2130	P.C.C. Lined Channel	788	285	467	641	819
2140	24" RCP	34	37	56	70	86
2142	18" RCP	17	19	29	36	44
2150	P.C.C. Lined Channel	788	255	423	584	776
2151	18" RCP	18	6	10	12	14
2160	P.C.C. Lined Channel	65	65	99	125	158
2170	24" RCP	32	54	80	101	123
2180	24" RCP	32	47	71	89	106
2190	Unlined Channel	9	27	41	51	62
2200	24" RCP	25	24	35	44	53

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Table IV-40
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
2210	Unlined Channel	71	18	26	33	41
2220	15" RCP	10	13	20	25	31
2230	Unlined Channel	907	187	321	460	638
2240	Unlined Channel	667	127	197	248	301
2250	2-2.5'x3.8' RCB	285	122	186	234	283
2260	Unlined Channel	122	115	173	219	278
2270	30" RCP	40	51	81	103	128
2280	Unlined Channel	56	42	66	84	105
2290	24" RCP	20	29	46	58	72
2300	48" RCP	120	56	84	105	129
2310	49"x32" RCPHE	88	51	77	96	118
2320	36" RCP	70	28	42	51	62
2330	Unlined Channel	3,840	70	164	270	377
2340	60" RCP	294	65	158	246	362
2350	Detention Facility	79	65	164	260	358
2360	30" RCP	42	8	12	15	18
2370	21" CMP	13	27	43	55	68
2380	Unlined Channel	49	28	44	56	70
2390	18" RCP	15	22	36	45	57
2400	8'x4' RCB	343	157	234	288	346
2410	6'x3.5' RCB	192	154	229	280	340
2420	65"x40" RCPA	170	149	223	276	334
2430	42" RCP	110	76	114	138	169
2432	18" RCP	5	9	14	18	22
2440	42" RCP	110	58	85	105	125
2450	36" RCP	82	48	69	86	102
2460	36" RCP	77	43	61	73	90
2470	30" RCP	54	34	48	60	71
2480	48" CMP	99	70	107	135	161
2485	48" CMP	99	64	97	119	145
2490	48" CMP	103	58	86	107	130
2495	18" CMP	8	5	8	11	12
2500	42" CMP	65	36	52	63	74
2505	36" CMP	55	31	45	53	64
2510	24" RCP	33	26	37	43	51

Table IV-41

WATERSHED LS-HIJK, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	320	0	(6)	300	1,415	2,035
2 yr.-5 yr.	1,630	730	(1)	30	1,980	4,370
5 yr.-10 yr.	400	0	(0)	0	2,170	2,570
10 yr.-25 yr.	0	230	(3)	550	1,910	2,690
>25 yr.	3,860	2,120	(3)	320	1,440	7,740
TOTAL	6,210	3,080	(13)	1,200	8,915	19,405

The model for watershed LS-HIJK includes a total of two detention facilities. Pertinent data on those facilities is summarized in the following table.

Table IV-42

WATERSHED LS-HIJK, EXISTING
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized 2 Yr. (ac-ft)	5 Yr. (ac-ft)	10 Yr. (ac-ft)	25 Yr. (ac-ft)
2090	Private, Planned	10.58	0.7	0.26	0.34	0.39	0.45
2350	Private, Recreational	137.70	10	8.38	11.42	12.77	13.65

15. WATERSHED LS-L

Watershed LS-L drains a total of 491 acres, of which 426 acres are tributary to the primary basin outlet. This primary outlet consists of an unimproved open channel at the south corporate limit approximately 1/2 mile west of Highway 71.

South of 139th Street, this watershed is largely undeveloped. North of 139th, the watershed is developed, although significant areas remain available for in-fill industrial development west of Botts Road.

A total of 37 subareas and 38 discrete pipe, channel, or culvert reaches were modelled for this watershed. Pertinent data for the area tributary to the primary outlet is summarized below:

Drainage Area:	425.58 ac.
Watershed Hydraulic Length:	6,800 ft.
Percent of Length Improved:	40 percent
Maximum Elevation:	1,067 ft. m.s.l.
Minimum Elevation:	954 ft. m.s.l.
Composite S.C.S. Curve Number:	77.1

Table IV-43 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-44.

Table IV-43

WATERSHED LS-L, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	Unlined Channel	113	387	592	773	989
1010	Unlined Channel	88	41	64	81	101
1020	Unlined Channel	81	30	46	56	72
1030	15" RCP	8	22	31	38	46
1040	Unlined Channel	61	19	27	34	40
1045	18" RCP	15	6	8	10	12
1050	Unlined Channel	87	357	561	730	932
1060	Unlined Channel	661	13	23	30	39
1070	Unlined Channel	98	166	261	343	435
1080	Unlined Channel	133	153	240	320	412
1090	Unlined Channel	743	149	223	294	378
1100	42" RCP	110	135	202	267	341
1110	Unlined Channel	126	110	166	222	287
1120	Unlined Channel	66	21	34	45	58
1130	Unlined Channel	71	15	25	31	38
1140	Unlined Channel	89	9	12	14	17
1150	Unlined Channel	19	68	110	142	182
1160	Unlined Channel	17	40	66	87	112
1170	24" CMP	17	12	21	27	36
1180	Unlined Channel	494	206	316	390	500
1190	Unlined Channel	482	167	265	331	408
1200	3-42" CMP	260	146	222	278	340
1210	P.C.C. Lined Channel	225	122	185	230	281
1220	6'x4' RCB	301	119	181	224	274
1225	P.C.C. Lined Channel	225	103	158	196	237
1230	P.C.C. Lined Channel	225	102	155	193	236
1240	73"x55" CMPA	166	94	145	180	222
1250	P.C.C. Lined Channel	184	89	136	170	208
1260	27" RCP	28	20	32	39	47
1270	21" RCP	16	9	13	17	21
1280	72"x44" CMPA	76	60	90	114	137
1283	P.C.C. Lined Channel	34	22	34	43	53
1285	21" RCP	17	7	11	14	18
1290	P.C.C. Lined Channel	127	38	57	70	86
1300	24" RCP	16	36	53	67	79
2000	Unlined Channel	51	36	60	78	101
2010	15" RCP	7	22	36	46	59
3000	Unlined Channel	42	32	54	70	89

Table IV-44

WATERSHED LS-L, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	4,940	0	(3)	90	130	5,160
2 yr.-5 yr.	1,580	0	(1)	70	440	2,090
5 yr.-10 yr.	0	340	(2)	160	80	580
10 yr.-25 yr.	2,260	1,210	(1)	40	0	3,510
>25 yr.	5,820	200	(1)	45	180	6,245
TOTAL	14,600	1,750	(8)	405	830	17,585

16. WATERSHED LS-MNOP

Watershed LS-MNOP consists of a series of small watersheds directly tributary to the Little Blue River upstream of Highway 150. The existing conditions model includes 6 points of discharge.

With the exception of an area immediately east of Highway 71, this watershed is completely developed within the corporate limits of Grandview. This watershed includes 39 acres in the City of Belton south of 155th Street, 30 acres of which are tributary to an existing 4.5'x3' RCB beneath 155th approximately 1,000 feet east of Highway 71.

A total of 42 subareas and 44 discrete pipe, channel, or culvert reaches were modelled for this watershed. The total tributary area included in the existing system model is 267.4 acres.

Table IV-45 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-46.

Table IV-45

WATERSHED LS-MNOP, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	36" RCP	77	193	292	360	446
1005	36" RCP	77	184	274	349	422
1010	36" RCP	77	175	261	330	396
1020	36" RCP	77	163	247	307	374
1030	36" RCP	77	152	229	284	349

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Table IV-45
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1040	36" RCP	77	142	217	265	324
1045	36" RCP	79	137	204	254	313
1050	36" RCP	79	124	192	232	285
1060	36" RCP	97	111	173	215	263
1070	30" RCP	60	98	145	179	220
1080	30" RCP	53	78	120	151	182
1090	27" RCP	42	62	96	117	143
1100	27" RCP	43	45	68	86	102
1110	24" RCP	34	38	57	71	85
1120	21" RCP	27	20	29	37	44
2000	30" RCP	53	22	34	43	54
2010	24" RCP	34	21	35	43	52
2015	24" RCP	34	20	31	40	49
2020	24" RCP	31	17	26	34	41
2025	24" RCP	31	13	19	24	29
2030	24" RCP	31	7	11	13	16
2040	24" RCP	31	3	5	6	7
3000	4'x3' RCB	136	175	182	190	199
3010	48" RCP	150	169	173	176	179
3020	48" RCP	188	163	163	164	164
3025	24" RCP	47	15	22	27	34
3030	48" RCP	144	50	80	102	129
3040	48" RCP	144	42	68	88	111
3050	Unlined Channel	586	43	69	89	111
3060	4.5'x3' RCB	144	32	52	68	86
4000	24" RCP	47	43	46	49	52
4005	21" RCP	23	39	41	43	45
4010	21" RCP	21	36	37	38	39
4020	18" RCP	9	8	12	14	17
4030	Unlined Channel	77	6	9	13	17
4040	18" CMP	8	4	7	10	13
5000	18" CMP	7	18	29	37	45
5010	Unlined Channel	75	17	27	34	42
5020	15" CMP	4	12	17	21	26
6000	24" CMP	16	102	106	106	107
6010	24" CMP	16	102	102	103	105
6020	Unlined Channel	100	97	97	97	97
6030	18" RCP	15	1	2	3	3
6040	30" RCP	49	42	62	78	95

Table IV-46

WATERSHED LS-MNOP, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	0	0	(2)	100	4,950	5,050
2 yr.-5 yr.	0	0	(0)	0	870	870
5 yr.-10 yr.	0	0	(1)	20	560	580
10 yr.-25 yr.	0	0	(0)	0	100	100
>25 yr.	1,560	0	(2)	70	1,390	3,020
TOTAL	1,560	0	(5)	190	7,870	9,620

17. WATERSHED LS-Q

This watershed drains a total of 228 acres, of which 146 acres are tributary to an 81"x59" CMPA across 134th Terrace immediately west of Park Hills Drive.

This watershed is fully developed, almost exclusively in single family residential development.

A total of 47 subareas and 48 discrete pipe, channel, or culvert reaches were modelled for this watershed. Pertinent data for the area tributary to the primary outlet is as follows:

Drainage Area:	146.44 ac.
Watershed Hydraulic Length:	4,450 ft.
Percent of Length Improved:	96 percent
Maximum Elevation:	1,007 ft. m.s.l.
Minimum Elevation:	920 ft. m.s.l.
Composite S.C.S. Curve Number:	82.0

Table IV-47 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-48.

Table IV-47

WATERSHED LS-Q, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	81"x59" CMPA	363	205	295	361	441
1010	18" CMP	9	6	9	11	13
1020	18" CMP	8	12	17	20	25
1030	P.C.C. Lined Channel	232	186	277	339	415
1035	21" CMP	13	12	19	24	29
1040	18" CMP	8	5	7	8	11
1050	P.C.C. Lined Channel	267	170	249	309	379
1060	24" CMP	14	11	16	20	23
1070	24" CMP	14	13	19	24	29
1080	P.C.C. Lined Channel	214	145	217	266	326
1090	81"x59" CMPA	133	144	212	263	330
1100	30" RCP	29	12	18	23	27
1110	P.C.C. Lined Channel	159	129	190	236	292
1115	P.C.C. Lined Channel	154	114	173	216	267
1118	P.C.C. Lined Channel	200	84	128	159	196
1119	24" CMP	18	7	11	15	19
1120	27" RCP	34	13	20	25	30
1130	15" RCP	8	11	16	20	24
1140	Unlined Channel	20	23	35	45	56
1150	42" RCP	73	15	22	27	33
1160	30" RCP	30	11	17	21	26
1170	30" RCP	55	3	5	6	7
1180	P.C.C. Lined Channel	240	59	90	111	136
1190	48" CMP	105	54	82	99	124
1200	42" CMP	63	45	70	82	100
1204	36" CMP	55	39	60	73	87
1208	24" CMP	17	10	15	19	22
1210	30" CMP	34	18	28	33	40
1220	24" CMP	20	14	22	25	32
2100	36" RCP	60	24	36	44	54
2110	36" RCP	67	21	31	39	47
2120	30" RCP	49	15	23	28	34
2130	30" RCP	46	9	13	16	20
3000	36" RCP	76	34	50	63	78
3005	36" RCP	67	26	39	48	59
3010	21" RCP	22	18	27	34	41

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Table IV-47
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
3015	15" RCP	9	4	6	8	10
3020	21" RCP	22	9	13	16	20
3030	24" RCP	41	1	1	2	2
4000	30" RCP	37	24	37	45	55
4010	24" RCP	23	15	22	28	35
5000	42" RCP	109	46	68	84	103
5005	36" RCP	60	44	65	81	98
5010	36" RCP	60	32	47	59	71
5020	36" RCP	100	29	42	53	65
5025	21" RCP	22	10	15	19	24
5030	30" RCP	44	12	17	21	26
5040	24" RCP	31	7	10	13	16

Table IV-48

WATERSHED LS-Q, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	900	0	(1)	60	620	1,580
2 yr.-5 yr.	0	1,640	(0)	0	1,370	3,010
5 yr.-10 yr.	0	535	(0)	0	750	1,285
10 yr.-25 yr.	0	0	(1)	50	1,250	1,300
>25 yr.	0	600	(0)	0	3,255	3,855
TOTAL	900	2,775	(2)	110	7,245	11,030

18. WATERSHED OC-A

Watershed OC-A encompasses the most northerly segment of the overall Oil Creek basin. Watersheds OC-B and OC-C are both tributary to this basin. A total of 482 acres are included in this basin. With the exception of a residential area and golf course in the control portion of the basin, this watershed is largely undeveloped.

A total of 40 subareas and 42 discrete pipe, channel, or roadway culvert reaches were modelled for this watershed.

Table IV-49 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand (including flow contributions from tributary watersheds) at a variety of return periods.

A summary evaluation by type of facility and present level of service is presented in Table IV-50.

Table IV-49

WATERSHED OC-A, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1000	Unlined Channel	1,433	1,570	2,084	2,482	3,402
1010	Unlined Channel	343	15	25	33	43
1020	Unlined Channel	166	9	16	21	27
1030	Unlined Channel	1,106	1,111	2,244	2,731	3,691
1040	Unlined Channel	19	133	224	294	381
1050	Unlined Channel	2,462	1,179	2,301	2,776	3,731
1060	24" CMP	23	16	24	30	37
1070	Unlined Channel	834	125	200	254	319
1080	42" CMP	67	44	70	86	107
1090	36" CMP	56	39	60	75	94
1100	36" CMP	61	37	57	72	89
1110	18" CMP	10	10	14	18	22
1120	30" CMP	36	25	39	48	60
1130	21" CMP	23	10	16	21	26
1140	24" CMP	20	13	19	25	28
1149	27" CMP	25	79	129	169	213
1150	Unlined Channel	231	83	135	173	216
1160	60" CMP	164	70	113	145	183
1170	54" CMP	131	53	87	112	141
1175	24" CMP	19	47	77	99	127
1180	36" CMP	56	35	58	76	96
1185	30" CMP	44	27	44	57	73
1190	42" CMP	95	15	26	34	42
1200	Unlined Channel	603	1,191	2,326	2,850	3,771
1210	P.C.C. Lined Channel	143	122	159	207	277
1215	18" RCP	5	5	7	9	11
1220	Unlined Channel	1,246	125	158	210	278
1230	6'x4' RCB	360	119	149	198	259
1240	24" CMP	22	11	17	22	27
1250	Unlined Channel	346	95	138	183	240
1260	72" CMP	283	133	131	175	229
1265	66" CMP	224	121	129	173	226
1270	Unlined Channel	88	75	119	160	212
1280	Unlined Channel	43	44	76	104	135
1290	Detention Facility	18	2	4	5	7

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Table IV-49
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Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
1300	Unlined Channel	4,065	1,218	2,316	2,816	3,775
1320	Unlined Channel	132	8	13	17	22
1330	6'x4' RCB	318	3	5	7	8
1340	Unlined Channel	1,082	1,218	2,321	2,870	3,823
1350	Unlined Channel	117	48	67	90	114
1360	Unlined Channel	108	27	50	67	88
1370	Unlined Channel	2,176	1,329	2,328	2,925	3,841

Table IV-50

WATERSHED OC-A, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	7,010	0	(1)	90	120	7,220
2 yr.-5 yr.	2,870	300	(0)	0	1,130	4,300
5 yr.-10 yr.	1,000	0	(0)	0	880	1,880
10 yr.-25 yr.	0	0	(0)	0	840	840
>25 yr.	5,610	0	(3)	170	440	6,220
TOTAL	16,490	300	(4)	260	3,410	20,460

The model for Watershed OC-A includes a total of one detention facility. Pertinent data on that facility is summarized in the following table.

Table IV-51

WATERSHED OC-A, EXISTING
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized 2 Yr. (ac-ft)	5 Yr. (ac-ft)	10 Yr. (ac-ft)	25 Yr. (ac-ft)
1290	Private, Agricultural	14.93	4	0.77	1.24	1.59	2.01

19. WATERSHED OC-B

Watershed OC-B consists of 162 acres in the overall Oil Creek basin. This watershed discharges to Watershed OC-A via an existing 8'x8.5' RCB beneath Highway 150 approximately 2,000 feet east of Highway 71. That discharge is tributary to Line 1040 of Watershed OC-A.

Development within this basin is limited to its lower third, immediately south of Route 150.

A total of 13 subareas and 14 discrete pipe, channel, or roadway, culvert reaches were modelled for this watershed. Pertinent data on the watershed is as follows:

Drainage Area:	162.10 ac.
Watershed Hydraulic Length:	4,480 ft.
Percent of Hydraulic Length Improved:	14 percent
Maximum Elevation:	1,075 ft. m.s.l.
Minimum Elevation:	940 ft. m.s.l.
Composite S.C.S. Curve Number:	76

Table IV-52 indicates the specific hydraulic capacity of each modelled reach relative to its current estimated demand at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-53.

Table IV-52

WATERSHED OC-B, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
2000	8'x8.5' RCB	1,020	160	251	328	418
2010	11'x12.5' Bridge	1,577	160	248	324	413
2020	Unlined Channel	89	143	232	295	381
2025	Unlined Channel	495	133	204	268	346
2030	30" CMP	49	8	13	17	21
2040	15" RCP	12	8	12	14	18
2050	P.C.C. Lined Channel	450	117	179	234	302
2060	18" RCP	18	7	11	14	16
2070	24" CMP	35	10	15	18	22
2080	Unlined Channel	152	99	156	202	253
2090	Unlined Channel	125	18	26	33	40
2095	18" CMP	10	18	26	33	40
2100	Unlined Channel	252	76	119	158	209
2110	Unlined Channel	70	47	81	107	140

Table IV-53

WATERSHED OC-B, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	400	0	(0)	0	160	560
2 yr.-5 yr.	1,020	0	(0)	0	0	1,020
5 yr.-10 yr.	0	0	(0)	0	350	350
10 yr.-25 yr.	0	0	(0)	0	0	0
>25 yr.	1,780	350	(2)	260	560	2,950
TOTAL	3,200	350	(2)	260	1,070	4,880

20. WATERSHED OC-C

Watershed OC-C encompasses a modelled area of 715 acres within the corporate limits of Grandview, and represents the most southerly segment of the overall Oil Creek basin. The watershed extends northerly from 155th Street, eventually discharging to Watershed OC-A at Line 1370.

Within the corporate limits, this watershed is almost completely undeveloped.

An additional 2,925 acres, situated within the City of Belton, are tributary to Watershed OC-C at two points (lines 4000 and 5000) along 155th Street. That area was the subject of a recent study commissioned by the City of Belton.

The existing condition, 10-year event hydrographs at 155th Street as identified in that study were furnished by the City of Belton, and have been directly incorporated into this analysis. Existing condition hydrographs for the 2, 5 and 25 year events were estimated by linear proportioning using the 10-year event as the basis. The estimated peak rates of inflow to Watershed OC-C are summarized below:

Table IV-54

OIL CREEK AT 155TH STREET
PEAK RATES OF INFLOW

Return Period (yrs.)	Peak Inflow at Line 4000 (cfs)	Peak Inflow at Line 5000 (cfs)
2	200	1,450
5	350	2,580
10	440	3,230
25	580	4,260

A total of 23 subareas and 23 discrete pipe, channel, or roadway culvert reaches were modelled for this watershed.

Table IV-55 indicates the specific hydraulic capacity of each reach relative to its current estimated demand discharge at a variety of return periods. A summary evaluation by type of facility and present level of service is presented in Table IV-56.

Table IV-55

WATERSHED OC-C, EXISTING
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge 2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)
3000	Unlined Channel	322	55	87	117	155
3010	Unlined Channel	394	25	45	62	82
3020	Detention Facility	106	12	27	41	58
3030	Detention Facility	106	32	70	113	266
3040	Unlined Channel	105	31	58	78	102
3050	Unlined Channel	37	49	68	90	119
3060	4'x2' RCB	98	35	63	85	111
3070	Unlined Channel	280	36	63	84	111
3080	2'x1.5' RCB	30	11	20	27	35
3100	Unlined Channel	899	1,307	2,382	3,014	3,978
3110	Unlined Channel	1,137	1,328	2,408	3,007	3,972
3115	Unlined Channel	264	181	274	325	424
3120	Unlined Channel	235	160	233	283	375
3130	Unlined Channel	92	66	88	116	151
3140	Unlined Channel	95	7	13	18	24
3150	Unlined Channel	208	35	63	86	112
3160	Unlined Channel	68	70	101	133	175
3170	Unlined Channel	84	48	82	106	138
3180	Unlined Channel	96	23	42	56	74
3190	Unlined Channel	665	1,317	2,391	3,014	3,995
3200	Unlined Channel	815	1,345	2,421	3,028	4,002
3210	Unlined Channel	815	1,382	2,500	3,123	4,120
3220	Unlined Channel	815	1,417	2,518	3,153	4,168

Table IV-56

WATERSHED OC-C, EXISTING
SYSTEM PERFORMANCE SUMMARY

Line Capacity	Unlined Channel (ft.)	Lined Channel (ft.)	Roadway Culvert (No.)	Roadway Culvert (ft.)	Enclosed System (ft.)	Total (ft.)
<2 yr.	7,300	0	(0)	0	0	7,300
2 yr.-5 yr.	1,250	0	(0)	0	0	1,250
5 yr.-10 yr.	2,880	0	(0)	0	0	2,880
10 yr.-25 yr.	0	0	(2)	90	0	90
>25 yr.	6,300	0	(0)	0	0	6,300
TOTAL	17,730	0	(2)	90	0	17,820

The model for Watershed OC-C includes a total of two detention facilities. Pertinent data on those facilities is summarized in the following table.

Table IV-57

WATERSHED OC-C, EXISTING
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized 2 Yr. (ac-ft)	5 Yr. (ac-ft)	10 Yr. (ac-ft)	25 Yr. (ac-ft)
3020	Private, Agricultural	185.01	30	6.49	11.33	14.90	18.88
3030	Private, Agricultural	150.31	12	5.08	8.65	11.17	11.68

V – IMPACT OF FUTURE LAND USE

V - IMPACT OF FUTURE LAND USE

A. GENERAL

This section presents a summary of the results of the detailed hydrologic and hydraulic analyses of the 20 watersheds within the corporate limits of Grandview based on future land usage and the existing storm drainage system. Future land use information was obtained from the Comprehensive Plan for Grandview supplied by the city. The purpose of this analysis is to define the impact of future changes in land use on the response of the existing drainage system.

Using the future land use classifications from the Comprehensive Plan, the following curve numbers were applied to determine composites for each subwatershed area. The composite curve number was based on a weighted average for the land use classes present in an area.

Classification	Curve Number
Open	70-75
Park	75
Low Density Residential	83
Medium Density Residential	87
High Density Residential	90
Schools; Govt-Institutional	91
Light Industrial - Office	92
Industrial Distribution - Warehouse	92
Office Campus	95
Commercial Retail	95

Overland flow lengths within individual subareas were also modified based on estimates of future increases in paved areas and channelized or enclosed storm drainage flows. No other data pertaining to the existing storm drainage system were revised.

B. WATERSHED SUMMARIES

This section presents additional detail on the impact of future land use on the existing drainage system watershed by watershed. It indicates the estimated capacity and compares the demand discharge for the existing and future land use conditions for each element of the major drainage system. The existing and future curve numbers are also included.

1. WATERSHED B-A

The drainage of approximately 395 acres of the watershed will be affected by future land use modifications. The substantial areas of open land will be almost completely developed. The majority of this watershed will eventually be classified as light industrial or industrial distribution.

Table V-1 indicates the specific hydraulic capacity of each modelled reach and compares existing and future 10-year demand discharges and curve numbers.

Table V-1

WATERSHED B-A, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	8'x4' RCB	480	105	156	75	81
1010	Detention Facility	294	102	152	80	86
1020	36" RCP	106	29	45	75	95
1030	Unlined Channel	85	75	118	75	92
1040	Unlined Channel	57	34	53	75	92
1050	18" CMP	8	22	34	75	92
1060	Unlined Channel	315	411	550	80	85
1070	24" CMP	18	415	544	75	92
1080	Unlined Channel	20	422	553	77	92
1090	Unlined Channel	16	92	146	75	92
1100	24" CMP	22	76	120	75	92
1110	24" RCP	34	48	74	80	92
1120	2'x1.5' RCB	23	44	69	75	92
1130	Unlined Channel	18	314	385	75	92
1140	24" CMP	18	21	21	75	92
1150	24" CMP	18	20	21	80	92
1160	Unlined Channel	38	286	347	75	92
1170	Unlined Channel	894	262	316	80	92
1180	2'x1.5' RCB	28	48	50	85	92
1190	Unlined Channel	85	46	48	90	92
1200	15" RCP	8	25	26	90	92
1210	1-60" CMP, 2-36" RCP	308	188	229	75	--
1220	Unlined Channel	385	188	231	75	--
1230	24" RCP	20	17	17	85	--
1240	8'x3' RCB	199	165	206	85	92
1250	36"x22" CMP	37	29	35	83	92
1260	8'x2' RCB	135	128	164	75	92
1270	Unlined Channel	440	128	165	85	92
1280	6'x3' RCB	152	125	161	75	90
1285	P.C.C. Lined Channel	260	125	163	80	90
1290	Unlined Channel	66	114	145	80	90
1300	50"x31" CMPA	29	101	126	85	90
1310	36" CMP	34	74	78	83	86
1320	Unlined Channel	20	54	56	83	92
1330	Unlined Channel	149	43	43	92	--
1340	27" CMP	20	40	40	83	--
2000	4'x2.5' RCB	137	141	152	83	92
2010	48" CMP	92	40	41	85	92
2020	43"x27" CMPA	46	39	40	85	92
2030	21" RCP	25	36	36	90	90
2040	Unlined Channel	140	96	106	80	92
2050	27" CMP	21	60	56	90	--

Table V-1 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
2055	24" RCP	28	33	28	92	--
2060	Detention Facility	31	30	25	92	--
2070	48" CMP, PCC Lined	88	39	42	88	92
2080	48" CMP, PCC Lined	88	40	40	92	--
3000	12" RCP	6	27	35	81	92
4000	4'x2.5' RCB	150	55	86	73	90
4010	Unlined Channel	139	48	75	74	90
5000	4'x2.5' RCB	150	96	140	70	75
5010	Unlined Channel	140	75	115	73	80
5020	2-24" RCP	92	57	92	80	92
5030	Unlined Channel	115	54	87	73	90

The model for watershed B-A includes a total of two detention facilities. Pertinent data on those facilities are summarized in the following table.

Table V-2

WATERSHED B-A, FUTURE LAND USE
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized Existing 10 Yr. (ac-ft)	Storage Utilized Future 10 Yr. (ac-ft)
1010	Private, Industrial	293.87	80	37.01	48.34
2060	Private, Planned	35.40	7.5	5.57	6.04

2. WATERSHED B-B

Substantial areas of this watershed are presently undeveloped and the majority of the land will be left undeveloped due to topographic constraints. However, the drainage of approximately 375 acres will be affected by future development and land usage modifications in the remainder of the watershed which will be a mixture of residential and light industrial areas.

Table V-3 indicates the specific hydraulic capacity of each reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-3

WATERSHED B-B, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	Unlined Channel	465	712	832	70	--
1010	Unlined Channel	102	141	171	72	78
1020	Unlined Channel	371	615	755	70	--
1030	Unlined Channel	414	605	763	70	72
1040	Unlined Channel	70	592	764	70	--
1050	Unlined Channel	99	143	293	72	--
1060	Detention Facility	116	128	269	78	85
1090	Detention Facility	32	179	254	75	87
1100	15" RCP	10	103	108	75	83
1110	Unlined Channel	36	105	109	83	--
1120	18" RCP	13	9	9	88	--
1130	42" RCP	103	76	80	83	--
1140	4'x2.5' RCB	70	61	68	75	88
1150	Unlined Channel	60	61	69	80	88
1170	Unlined Channel	31	44	52	83	90
1180	24" CMP	20	21	26	83	92
1190	Unlined Channel	53	108	117	75	81
1195	15" RCP	7	13	12	90	87
1200	5'x3' RCB	225	91	101	83	87
1220	Unlined Channel	86	84	95	75	83
1230	15" RCP	6	25	27	88	92
1240	Unlined Channel	110	448	538	73	80
1250	Unlined Channel	73	96	149	73	87
1260	4.5'x4' RCB	269	311	343	75	--
1270	Unlined Channel	179	310	339	73	--
1280	87"x63" CMPA	298	37	342	75	83
1290	36" CMP	69	66	77	77	90
1300	30" CMP	46	52	55	82	86
1310	73"x55" CMPA	215	236	258	78	--
1320	Unlined Channel	103	225	253	78	--
1330	Unlined Channel	83	199	230	78	80
1340	65"x40" CMPA	103	150	177	83	--
1350	58"x36" CMPA	74	121	147	90	--
1360	36"x22" CMPA	31	26	31	83	90
1370	50"x32" CMPA	52	88	109	83	90
1380	Unlined Channel	125	81	106	83	89
1390	3'x2' RCB	60	54	73	79	90

The model for watershed B-B includes a total of two detention facilities. Pertinent data on those facilities are summarized in the following table.

Table V-4

WATERSHED B-B, FUTURE LAND USE
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized Existing 10 Yr. (ac-ft)	Storage Utilized Future 10 Yr. (ac-ft)
1060	Private, Recreational	132.63	8	7.68	9.06
1090	Private, Recreational	88.43	5	6.97	4.98

3. WATERSHED B-CD

Currently, this watershed is largely undeveloped. Future plans indicate the largest portion of the area will be developed for industrial uses. The drainage of approximately 665 acres will be affected by these modifications.

Table V-5 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-5

WATERSHED B-CD, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	Unlined Channel	1,349	390	566	72	--
1010	10'x7' RCB	960	381	560	75	80
1020	Unlined Channel	102	91	133	70	75
1030	Unlined Channel	110	64	103	73	86
1040	Unlined Channel	24	32	57	73	92
1049	18" CMP	9	40	53	72	80
1050	Unlined Channel	148	287	443	72	--
1060	Unlined Channel	121	201	301	71	--
1070	Unlined Channel	53	185	280	71	75
1080	Unlined Channel	15	156	245	72	82
1090	30" RCP	48	107	186	70	92
1100	Unlined Channel	74	109	185	73	92
1110	Unlined Channel	43	64	107	74	92
1120	Unlined Channel	64	164	234	73	--
1130	30" CMP	29	161	233	70	--
1140	Unlined Channel	26	163	234	72	--
1150	Detention Facility	106	156	229	73	83
1160	Detention Facility	645	152	224	80	--
1170	15" CMP	6	21	27	75	--
1180	Unlined Channel	119	20	25	75	--
1190	15" CMP	6	16	23	78	92

Table V-5 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1200	Unlined Channel	56	225	329	70	--
1210	24" RCP	28	197	297	70	92
1212	Unlined Channel	51	74	100	80	92
1214	Detention Facility	22	20	39	85	91
1220	Unlined Channel	51	40	70	73	92
1230	Detention Facility	79	30	52	77	92
1240	Unlined Channel	32	88	130	73	92
1250	30" RCP	58	41	51	80	92
1260	Detention Facility	41	11	11	90	--
2000	5'x2.5' RCB	105	385	564	73	78
2010	Unlined Channel	28	368	545	72	80
2020	10'x6' RCB	900	339	497	70	80
2030	Unlined Channel	48	347	508	70	80
2040	Unlined Channel	31	324	459	70	83
2050	Unlined Channel	39	247	326	78	87
2060	Unlined Channel	32	214	292	73	87
2070	42" CMP	54	167	227	75	92
2080	24" RCP	16	149	199	70	92
2100	Unlined Channel	212	158	207	72	92
2105	22"x14" CMPA	7	32	47	76	92
2110	22"x14" CMPA	7	110	133	86	92
2120	Unlined Channel	73	103	123	83	92
2130	24" RCP, 36" RCP	59	82	96	70	92
2140	Unlined Channel	129	83	98	85	92
2150	24" CMP	16	65	76	82	87
2160	24" CMP	16	41	49	83	92
3000	6'x5' RCB	450	212	282	75	80
3010	Unlined Channel	79	192	259	73	80
3020	Unlined Channel	15	116	158	70	78
3030	Unlined Channel	35	78	104	72	80
3040	2'x1.5' RCB	28	18	21	74	80

The model for watershed B-CD includes a total of five detention facilities. Pertinent data on those facilities are summarized in the following table.

Table V-6

WATERSHED B-CD, FUTURE LAND USE
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized Existing 10 Yr. (ac-ft)	Storage Utilized Future 10 Yr. (ac-ft)
1150	Private, Recreational	217.71	3	3	2.95
1160	Private, Recreational	205.52	36	12.99	16.85
1214	Unplanned	22.76	--	2.96	3.31
1230	Unplanned	32.99	--	2.73	4.44
1260	Private, Planned	9.06	3	1.21	1.21

4. WATERSHED B-E

This watershed is almost totally undeveloped. Ultimately the majority of the area will be developed for industrial use which will impact the drainage of virtually the entire watershed.

Table V-7 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-7

WATERSHED B-E, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	Unlined Channel	20	266	421	71	79
1010	5'x7' Stone Culvert	349	215	354	74	92
1020	Unlined Channel	18	183	291	74	90
1030	Unlined Channel	27	137	222	75	92
1040	Unlined Channel	27	36	57	75	92
2000	Unlined Channel	116	114	189	72	85
2010	18" CMP	10	68	119	72	92
2015	Unlined Channel	20	57	103	73	92
2020	Detention Facility	143	53	96	75	92
2030	Detention Facility	67	46	82	74	92
3000	Unlined Channel	98	246	367	70	80
3010	Detention Facility	367	212	317	71	82
3020	Unlined Channel	162	216	304	70	81
3030	Unlined Channel	19	183	270	70	81
3040	Unlined Channel	6	157	222	72	77
3050	Roadway Overflow	--	18	28	75	92
3060	Roadway Overflow	--	95	144	75	89

The model for watershed B-E includes a total of three detention facilities. Pertinent data on those facilities are summarized in the following table.

Table V-8

WATERSHED B-E, FUTURE LAND USE
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized Existing 10 Yr. (ac-ft)	Storage Utilized Future 10 Yr. (ac-ft)
2020	Private, Agricultural	29.84	1.5	0.76	1.16
2030	Private, Agricultural	23.19	0.9	0.70	0.86
3010	Private, Recreational	129.51	6	4.17	5.23

5. WATERSHED LN-A

Based on projected land use modifications, the drainage of approximately 418 of the 494 acres within the corporate limits will be affected to some degree. The largest portion of this area will eventually be classified as low density residential.

Table V-9 indicates the specific hydraulic capacity of each modelled reach of the basin within Grandview and compares the existing and future 10-year demand discharges and curves numbers. (The demand discharges include flow contributions from tributary watersheds.)

Table V-9

WATERSHED LN-A, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	Two 17'-2"x11'-4" CMPA	3,511	2,747	3,101	75	--
1010	Unlined Channel	178	43	43	76	--
1020	Riprap Lined Channel	431	410	473	76	--
1030	24" RCP	32	11	13	76	83
1040	Unlined Channel	404	393	466	76	--
1050	Two 8'-7"x5'-11" CMPA	576	385	460	75	--
1060	Unlined Channel	368	393	473	74	83
1070	Unlined Channel	435	302	357	75	83
1090	Unlined Channel	736	2,635	2,971	72	--
1095	24" CMP	13	37	48	75	83
1100	Unlined Channel	376	2,621	2,954	73	--
1110	Unlined Channel	619	2,380	2,717	75	78
1120	12'x6' RCB, 14'x6' RCB	1,758	2,363	2,688	75	--
1130	30" RCP	42	33	43	75	83
1140	Unlined Channel	1,029	2,379	2,699	72	78
1150	18" RCP	14	22	24	79	83

Table V-9 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1159	Unlined Channel	310	112	117	75	--
1160	48" RCP	99	113	117	83	--
1170	42" RCP	142	100	105	81	83
1180	36" RCP	106	78	81	83	--
1190	24" RCP	24	22	27	79	83
1200	30" RCP	69	49	49	83	--
1210	24" RCP	37	30	30	83	--
1220	Unlined Channel	975	2,380	2,705	77	80
1230	30" RCP	41	43	43	83	--
1240	24" RCP	39	26	26	75	83
1241	24" RCP	19	25	25	83	--
1250	Unlined Channel	331	276	283	75	81
1251	Unlined Channel	255	276	282	75	83
1260	54" RCP	184	260	260	83	--
1270	48" RCP	152	258	258	83	--
1280	48" RCP	187	210	210	83	--
1290	Unlined Channel	1,024	2,265	2,594	80	81
1300	47'x6.5' Bridge	3,062	2,266	2,585	75	--
1310	Unlined Channel	806	2,263	2,590	72	84
1320	Unlined Channel	404	1,162	1,186	74	87
1330	Unlined Channel	557	1,183	1,183	82	--
1340	Unlined Channel	395	1,676	1,988	73	82
1350	Unlined Channel	260	1,701	2,030	72	86

6. WATERSHED LN-BC

When fully developed the majority of the land in this watershed will be classified as commercial retail. These future modifications will affect drainage of approximately 212 acres.

Table V-10 indicates the specific hydraulic capacity of each reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-10

WATERSHED LN-BC, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
4000	Unlined Channel	547	1,253	1,413	78	81
4010	21" CMP	4	20	20	83	--
4020	P.C.C. Lined Channel	2,700	1,266	1,407	75	85
4030	54" CMP	136	401	401	83	--
4040	54" CMP	136	367	367	83	--
4050	54" CMP	136	212	212	83	--
4060	P.C.C. Lined Channel	2,340	957	1,100	75	87
4065	P.C.C. Lined Channel	1,785	956	1,096	81	83
4070	48" CMP	103	172	195	80	95
4080	48" CMP	81*	135	135	75	--
4090	48" RCP	176	136	136	83	--
4100	Unlined Channel	139	778	903	75	--
4110	4'x4' RCB	156	80	80	85	--
4120	4'x2.5' RCB	70	47	47	95	--
4130	6'x6' RCB	540	595	735	85	--
4140	6'x6' RCB	540	597	742	95	--
4142	72" RCP	424	572	709	98	--
4144	36" RCP	79	205	235	98	--
4146	24" RCP	27	65	79	85	95
4148	27" RCP	37	98	113	95	--
4150	27" RCP	37	73	89	85	95
4152	30" RCP	60	64	76	83	95
4154	24" RCP	23	26	28	88	95
4159	54" RCP	238	370	468	95	--
4160	54" RCP	216	344	425	75	95
4170	Unlined Channel	107	67	112	75	95
4180	Unlined Channel	536	275	320	75	95
4190	Unlined Channel	276	33	45	85	95
4200	36" RCP	56	29	39	85	95
4210	36" RCP	56	22	30	80	95
4220	48" CMP	106	225	249	75	95
4230	Unlined Channel	200	228	254	83	95
4240	P.C.C. Lined Channel	228	203	223	78	92
4250	72"x44" CMPA	102	159	163	83	--
4260	72"x44" CMPA	102	142	147	83	--
4270	60" CMP	125	124	129	75	83
4275	36" RCP	30	23	23	78	--
4276	30" CMP	19	12	12	83	--
4280	54" CMP	111	106	113	83	--
4281	36" CMP	38	7	7	83	--
4290	48" CMP	81	100	103	83	--

Table V-10 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
4295	48" CMP	73	86	90	83	--
4300	48" CMP	73	78	81	83	--
4305	42" CMP	55	55	61	83	--
4310	36" CMP	29	47	53	83	88
4320	30" CMP	21	26	28	87	91

*Line 4080 theoretical capacity; line is totally ineffective at present.

7. WATERSHED LN-DE

Future land usage modifications will affect the drainage system for approximately 270 acres. When complete, development will be a mixture of primarily commercial-retail and high density residential areas.

Table V-11 indicates the specific hydraulic capacity of each reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-11

WATERSHED LN-DE, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
3000	Unlined Channel	139	617	759	71	85
3010	Unlined Channel	193	639	765	71	85
3020	Unlined Channel	64	52	70	74	86
3025	24" CMP	29	16	20	80	89
3030	Unlined Channel	191	633	709	70	88
3040	Unlined Channel	135	649	704	70	90
3045	Unlined Channel	280	645	673	70	87
3050	78" CMP	296	633	664	75	95
3055	24" CMP	6	19	30	77	95
3060	112"x75" CMPA	178	133	145	85	--
3065	71"x47" CMPA	67	33	35	88	91
3070	Unlined Channel	297	99	109	77	92
3080	42" CMP	98	73	72	90	--
3085	36" CMP	65	34	33	88	--
3086	30" CMP	37	22	21	90	87
3090	102" CMP	503	494	497	83	85
3100	8'x4' RCB	480	477	479	83	--
3110	53"x34" RCPHE	48	41	46	75	93
3115	2-27" RCP	42	34	34	93	--

Table V-11 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
3120	8'x4' RCB	371	446	494	75	95
3125	6'x4' RCB	225	349	391	75	95
3130	54" CMP	157	98	112	85	95
3140	48" CMP	99	87	99	90	95
3145	18" RCP	18	17	18	90	95
3150	3'x2' RCB	83	65	79	85	--
3160	3'x2' RCB	84	48	57	85	92
3170	Unlined Channel	2,429	349	391	80	91
3180	24" RCP	31	25	25	83	--
3200	72"x44" CMPA	164	309	350	83	--
3210	36" CMP	17	16	16	83	--
3215	36" CMP	27	6	6	83	--
3220	21" RCP	29	34	46	80	90
3225	18" RCP	21	24	34	77	95
3230	54" RCP	193	243	264	83	--
3235	30" CMP	23	23	24	88	90
3240	42" RCP	135	208	230	88	--
3250	24" RCP	10	42	42	83	--
3251	18" RCP	8	26	26	83	--
3260	42" RCP	135	146	174	83	87
3270	36" RCP	67	49	60	75	95
3280	30" RCP	65	39	44	88	94
3290	36" RCP	82	84	89	78	--
3300	36" RCP	60	66	70	83	85
3310	27" RCP	44	31	35	88	94

8. WATERSHED LN-F

When development is complete the majority of this watershed will be classified as low density residential. Land use modifications will affect drainage of 195 acres.

Table V-12 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-12

WATERSHED LN-F, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
2000	Unlined Channel	771	634	716	73	79
2010	Unlined Channel	969	93	104	74	82
2015	Unlined Channel	183	55	55	74	--
2020	30" RCP	45	51	51	83	--
2030	30" RCP	31	33	33	83	--
2040	Unlined Channel	594	534	606	76	81
2050	Unlined Channel	1,208	482	550	75	82
2060	Unlined Channel	116	27	27	81	--
2080	Unlined Channel	875	431	483	75	83
2090	54" CMP	155	440	487	75	--
2100	Unlined Channel	528	438	488	74	82
2110	Unlined Channel	594	396	438	73	83
2120	Unlined Channel	637	121	127	74	83
2130	42" CMP	102	110	113	75	--
2140	42" CMP	62	44	44	83	--
2150	30" CMP	33	18	18	83	--
2155	24" CMP	41	14	14	83	--
2160	36" CMP	75	66	70	83	--
2170	30" CMP	49	41	45	83	--
2175	24' CMP	29	38	44	85	90
2180	42" CMP	80	233	245	75	--
2190	Unlined Channel	632	233	251	76	79
2200	72" CMP	371	195	208	81	--
2210	60" CMP	104	177	190	83	--
2220	30" CMP	42	29	29	83	--
2230	48" CMP	120	122	134	83	--
2240	24" CMP	11	29	30	80	83
2250	42" CMP	86	77	88	80	83
2260	36" CMP	65	62	72	80	85

9. WATERSHED LS-AB

The watershed is highly developed, primarily as low density residential with little potential for significant additional development. Open areas situated east of the Highgrove Estates subdivision were acquired by the Corps of Engineers for the Longview Lake project. Future land usage modifications will affect the drainage of only 130 acres of this watershed.

Table V-13 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-13

WATERSHED LS-AB, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	10'-2"x14'-11" CMPA	1,272	1,018	1,037	75	--
1010	Unlined Channel	161	31	31	77	--
1020	30" CMP	33	36	36	83	--
1025	Unlined Channel	908	968	988	76	--
1030	Unlined Channel	184	965	983	76	--
1035	P.C.C. Lined Channel	1,733	858	866	75	--
1039	Unlined Channel	145	52	59	75	--
1040	36" RCP	73	50	57	83	89
1050	24" CMP	20	38	38	82	--
1060	2-7'x4', 2-7.5'x4' RCB	1,240	832	842	83	--
1070	21" CMP	11	17	18	80	83
1080	P.C.C. Lined Channel	1,733	791	798	83	--
1090	24" CMP	21	26	26	83	--
1100	21" CMP	14	16	16	81	--
1110	P.C.C. Lined Channel	1,463	755	762	83	--
1120	24" CMP	17	31	31	83	--
1130	21" RCP	17	25	25	83	--
1140	8.5'x5.5' RCB, 54" RCP	759	704	714	75	--
1150	P.C.C. Lined Channel	1,755	700	712	78	81
1160	30" CMP	33	22	21	84	83
1170	21" RCP	29	25	25	83	--
1180	P.C.C. Lined Channel	1,279	627	635	82	--
1181	30" CMP	40	20	20	83	--
1182	P.C.C. Lined Channel	603	600	619	78	81
1183	24" CMP	16	17	17	83	--
1190	42" RCP	94	97	97	83	--
1195	42" RCP	92	95	95	83	--
1200	30" RCP	57	46	46	83	--
1210	24" RCP	40	42	42	83	--
1220	8'x4' RCB, 8'x5' RCB	701	497	503	75	--
1230	P.C.C. Lined Channel	630	493	501	83	--
1240	7'x4' RCB, 48" RCP	370	459	464	75	--
1250	P.C.C. Lined Channel	578	458	464	83	--
1260	30" RCP	48	74	74	83	--
1270	P.C.C. Lined Channel	46	47	47	83	--
1274	Unlined Channel	133	25	25	81	--
1278	24" RCP	18	14	14	84	--
1280	15" CMP	6	14	14	83	--
1290	P.C.C. Lined Channel	413	363	369	83	--
1300	15" RCP	11	16	16	83	--
1310	30" CMP	33	47	47	83	--
1320	24" CMP	18	34	34	83	--
1330	7.5'x4' RCB	376	293	301	75	--

Table V-13 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1340	Unlined Channel	295	293	300	80	--
1350	24" RCP	23	26	26	83	--
1360	48" RCP, 48" CMP	262	221	234	75	--
1370	21" RCP	17	18	18	83	--
1380	Unlined Channel	572	204	216	77	82
1390	48" CMP	141	179	184	87	81
1400	36" CMP	35	34	31	87	83
1430	Unlined Channel	884	139	149	83	--
1440	42" CMP	80	120	129	83	84
1450	36" CMP	60	103	112	88	--
1460	30" CMP	40	50	61	80	89
1470	30" CMP	40	39	46	77	92
1480	30" CMP	40	33	35	88	91
2000	72" CMP	330	172	174	75	--
2010	Unlined Channel	88	15	15	77	--
2020	Unlined Channel	88	3	2	87	75
2030	Unlined Channel	114	159	162	75	--
2040	Unlined Channel	671	42	42	75	--
2060	Unlined Channel	206	100	103	75	--
2070	36" CMP	68	72	76	80	83
2080	21" CMP	11	14	14	83	--
2090	21" CMP	13	21	21	85	82

10. WATERSHED LS-C

This watershed is largely developed, primarily as low density residential areas, with remaining developable lands generally bounded by Byars Road and Belmont between 137th Street and 140th Street. This small amount of future land use modification will affect the drainage of only 22 acres of this watershed.

Table V-14 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-14

WATERSHED LS-C, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	72"x44" CMPA	94	129	131	83	--
1010	72"x44" CMPA	84	114	115	83	--
1020	48" CMP	120	111	112	83	85
1030	42" CMP	98	109	110	70	--
1040	18" CMP	8	11	12	83	87
1050	42" CMP	98	98	98	70	--
1060	24" RCP	28	98	98	83	--
1070	Unlined Channel	79	93	93	79	--
1074	36" CMP	53	64	64	70	--
1078	21" CMP	14	16	16	79	--
1080	18" CMP	8	9	9	83	--
1090	36" RCP	77	48	48	83	--
1100	36" RCP	60	38	38	83	--
1110	30" CMP	28	28	28	83	--
1120	18" CMP	12	18	18	83	--
1130	18" CMP	10	7	7	83	--
1140	18" CMP	10	9	9	83	--
2000	50"x31" CMPA	30	46	46	83	--
2010	43"x27" CMPA	23	37	37	83	--
2020	24" RCP	27	31	31	70	--
2025	Unlined Channel	47	30	30	83	--
2030	18" CMP	7	29	29	70	--
2040	18" CMP	6	15	15	83	--
2050	15" CMP	4	14	14	83	--
3000	24" RCP	20	19	19	83	--
4000	43"x27" CMPA	35	47	47	83	--
4010	29"x18" CMPA	7	13	13	83	--
4020	18" CMP	12	6	6	83	--
4030	36"x22" CMPA	33	29	29	79	--
5000	29"x18" CMPA	10	95	103	78	--
5010	Unlined Channel	15	88	95	70	75
5020	Unlined Channel	9	16	16	75	--
5040	15" CMP	5	9	9	83	--
5050	Unlined Channel	19	63	69	70	80

Table V-14 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
5060	Unlined Channel	23	59	62	75	79
5070	2-24" CMP	36	44	44	83	--
5080	24" CMP	13	25	25	70	--
5090	15" CMP	7	6	6	83	--
5100	24" CMP	13	19	19	83	--
5110	18" CMP	10	12	12	83	--

11. WATERSHED LS-D

This watershed is highly developed primarily as low density residential. Previously platted areas south of Highgrove Road are currently under residential development, and are considered as developed in this analysis. Remaining significant parcels subject to development are situated at the upstream end of the watershed, lying north and south of Main Street west of Beacon. When future development is complete the drainage of approximately 151 acres will be affected somewhat.

Table V-15 indicates the specific hydraulic capacity of each reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-15

WATERSHED LS-D, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	2-8'x6' RCB	1,145	916	944	72	77
1004	Unlined Channel	926	890	911	70	75
1008	Unlined Channel	926	906	927	74	--
1012	Unlined Channel	912	894	923	76	83
1015	36" RCP	30	45	45	85	--
1018	30" RCP	30	33	33	83	--
1020	30" RCP	30	24	24	70	--
1025	18" RCP	18	24	24	83	--
1030	18" RCP	7	11	11	83	--
1040	2-8'x4' RCB, 1-10'x5' RCB	823	820	849	88	--
1050	P.C.C. Lined Channel	780	822	850	83	--
1060	36" CMP	50	63	63	83	--
1064	30" CMP	28	39	39	83	--
1068	21" CMP	15	23	23	83	--

Table V-15 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1070	2-7.5'x4' RCB, 1-10'x4' RCB	985	744	774	70	--
1075	15" RCP	9	24	24	83	--
1080	P.C.C. Lined Channel	540	360	387	83	--
1090	7'-5' RCB	336	357	384	83	--
1092	30" CMP	33	25	25	83	--
1094	27" CMP	27	17	17	83	--
1096	18" CMP	10	13	13	83	--
1100	P.C.C. Lined Channel	208	330	357	83	--
1110	5'-4"x4' RCB	186	320	345	83	--
1115	P.C.C. Lined Channel	328	313	340	83	--
1120	Unlined Channel	231	317	342	79	83
1140	Unlined Channel	59	281	301	79	--
1150	Unlined Channel	79	103	103	79	--
1160	42" RCP	105	55	55	90	--
1170	30" RCP	54	34	34	90	--
1180	Unlined Channel	162	176	200	75	80
1190	42" RCP	103	162	182		
1200	43"x27" CMPA	37	12	12	83	--
1220	36" RCP	81	142	162	88	--
1230	36" RCP	106	141	164	83	--
1234	36" RCP	106	117	135	88	95
1238	36" RCP	106	93	108	85	--
1242	36" RCP	75	86	102	70	--
1246	18" RCP	5	22	25	75	80
1250	30" RCP	65	66	78	83	86
1254	27" RCP	59	56	69	76	92
1258	21" RCP	12	13	16	79	88
1262	24" RCP	36	40	44	88	--
1266	24" RCP	29	37	43	76	95
1270	18" RCP	14	28	30	92	95
1280	P.C.C. Lined Channel	427	367	375	83	--
1290	30" CMP	40	45	45	83	--
1300	18" CMP	11	34	34	83	--
1310	15" CMP	7	21	21	83	--
1320	73"x55" CMPA	196	307	315	83	--
1325	18" CMP	12	9	9	83	--
1330	P.C.C. Lined Channel	223	303	311	83	--
1340	36" CMP, 24" CMP	37	55	55	83	--
1350	30" CMP, 18" CMP	52	38	38	79	--
1360	P.C.C. Lined Channel	309	253	259	83	--
1370	72"x44" CMPA	117	226	228	80	--
1380	54" CMP	111	218	220	79	83
1390	54" CMP	111	211	215	83	--
1400	54" CMP	111	216	258	83	--
1410	54" CMP	111	209	249	83	--
1420	48" CMP, 58"x36" CMPA	161	200	242	79	--
1425	48" CMP, 43"x27" CMPA	118	139	167	70	--

Table V-15 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1430	58"x36" CMPA	77	56	70	79	--
1440	36" CMP	64	39	53	79	--
1450	36" CMP	51	30	43	70	--
1455	3'x2' RCB, 24" RCP	62	30	45	79	95
1460	P.C.C. Lined Channel	135	138	167	83	--
1470	42" RCP	69	136	165	83	--
1480	Unlined Channel	210	131	159	78	88
1485	Unlined Channel	22	102	112	83	91
1490	36" RCP	49	86	93	83	95
1495	30" CMP	28	70	71	88	--
1500	Unlined Channel	198	68	68	92	--
1510	50"x31" CMPA	60	61	64	85	--
1515	50"x31" CMPA	60	61	64	85	--
1518	50"x31" CMPA	59	60	63	85	--
1520	24" CMP	14	29	29	82	--
1530	36" RCP	50	31	34	90	95

12. WATERSHED LS-EF

This watershed is highly developed as a mixture of residential, office and commercial areas. Future development is expected to consist largely of in-fill development and some rezoning. An exception is the present undeveloped tract adjacent to King Louie, west of 71 Highway and south of 135th Street. Commercial and industrial development is linear in nature, extending along the Highway 71 frontage and along Main Street west of Highway 71. When future development is complete drainage from approximately 189 acres will be affected to at least some degree.

Table V-16 indicates the specific hydraulic capacity of each modelled reach of the basin and compares the existing and future 10-year demand discharges and curve numbers. (The discharges include flow contributions from Watershed LS-HIJK.)

Table V-16

WATERSHED LS-EF, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	52'x10' Bridge Opening	3,130	1,430	1,614	70	--
1010	30" RCP	41	15	19	83	93
1020	Unlined Channel	719	1,433	1,616	79	95
1030	Unlined Channel	408	898	970	75	95
1040	30" RCP	18	42	42	83	--
1050	14'x4' RCB	624	576	673	80	87
1055	P.C.C. Lined Channel	971	568	663	79	84
1060	Unlined Channel	502	571	671	78	85
1065	P.C.C. Lined Channel	887	537	610	83	85
1070	10'x4' RCB	453	530	622	85	95
1072	24" RCP	28	41	45	90	95
1075	54" RCP	205	492	580	90	95
1080	54" RCP	186	483	573	90	95
1085	42" RCP	105	439	504	83	89
1090	36" RCP	64	60	85	85	--
1100	3'x2' RCB	49	26	50	70	92
1110	Unlined Channel	253	20	21	85	--
1120	24" RCP	28	12	13	83	87
1130	Unlined Channel	609	425	488	80	95
1140	46"x31" CMPA	56	412	468	80	91
1150	Unlined Channel	602	395	439	90	95
1160	49"x33" CMPA	52	391	437	79	91
1170	24" CMP	9	41	52	83	95
1180	5'x4' RCB	300	330	354	85	--
1190	3'x2' RCB	22	57	62	83	91
1192	Unlined Channel	20	38	41	80	86
1194	15" CMP	7	23	23	79	--
1200	Unlined Channel	415	259	278	85	--
1210	4'x2.5' RCB	92	173	182	83	89
1220	24" RCP	34	160	168	70	--
1230	18" CMP	9	58	66	85	89
1240	24" CMP	24	102	105	83	--
1250	24" CMP	18	91	92	79	--
1260	18" CMP	8	44	45	81	83
1270	15" CMP	8	9	9	90	--
1280	Unlined Channel	69	88	97	85	--
1290	30" RCP	74	63	71	88	95
1300	18" RCP	15	34	38	90	--
1310	15" RCP	9	31	34	88	95

13. WATERSHED LS-G

This watershed is largely undeveloped except for those areas immediately adjacent to U.S. Highway 71, and the River Oaks subdivision. A significant feature is the River Oaks golf course, which will tend to limit future conversion to impervious surfaces in the central third of this watershed.

Ultimate land use will be a mixture of primarily low density residential and open areas (including the golf course). The drainage from approximately 417 acres will be affected by these future land usage modifications.

Table V-17 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-17

WATERSHED LS-G, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	Unlined Channel	218	337	444	70	83
1010	Unlined Channel	260	271	325	70	83
1020	Unlined Channel	170	91	134	70	81
1030	Unlined Channel	170	71	108	70	82
1100	18" CMP	8	159	215	70	--
1103	Unlined Channel	114	151	210	70	81
1105	1-16", 1-18" CMP	16	47	75	70	83
1110	Unlined Channel	161	36	56	70	83
1115	15" CMP	5	78	153	70	--
1120	Unlined Channel	28	79	159	70	78
1130	Detention Facility	99	74	129	70	83
1140	Detention Facility	64	83	147	70	83
1150	Unlined Channel	71	77	126	70	85
1200	12" CMP	3	75	131	70	--
1205	Unlined Channel	59	74	132	70	81
1210	Detention Facility	99	62	121	70	83
1220	Unlined Channel	29	65	111	70	85
1300	Unlined Channel	28	91	98	70	--
1310	24" CMP	18	27	42	70	83
1315	Unlined Channel	28	33	49	70	--
1320	Unlined Channel	28	33	49	70	--
1330	Unlined Channel	113	34	50	70	81
1400	30" CMP	41	39	39	83	--
1410	18" CMP	17	27	27	83	--
1500	24" CMP	26	31	30	83	78
1505	24" CMP	26	25	24	83	79
1510	18" CMP	15	19	19	83	--
1600	30" CMP	23	47	49	83	79
1610	30" CMP	23	24	27	70	78
1620	30" CMP	46	14	14	83	--

Table V-17 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1650	Unlined Channel	153	33	44	70	80
1655	36"x22" CMPA	14	13	16	73	79
1700	2-30" RCP	75	112	139	75	87
1710	Unlined Channel	77	101	123	75	87
1720	36" RCP	77	99	117	83	--
1725	3'x2' RCB	69	91	110	83	--
1730	3'x2' RCB	69	74	93	78	86

The model for watershed LS-G includes a total of three detention facilities. Pertinent data on those facilities are summarized in the following table.

Table V-18

WATERSHED LS-G, FUTURE LAND USE
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized Existing 10 Yr. (ac-ft)	Storage Utilized Future 10 Yr. (ac-ft)
1130	Private, Agricultural	53.71	2.2	1.78	2.19
1140	Private, Agricultural	47.89	1.0	0.93	0.94
1210	Private, Agricultural	41.87	1.8	1.20	1.67

14. WATERSHED LS-HIJK

Completion of future land use modifications will affect the drainage system for approximately 417 acres although to a relatively small degree.

Table V-19 indicates the specific hydraulic capacity of each reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-19

WATERSHED LS-HIJK FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
2000	12'x6' RCB	939	902	969	83	85
2010	12'x6' RCB	922	876	961	85	--
2011	15" CMP	2	11	13	87	95
2020	P.C.C. Lined Channel	1,800	867	940	87	--
2021	36" RCP	52	33	33	95	--
2025	15" CMP	7	27	31	87	95
2030	14'x6' RCB	1,210	825	897	70	--
2040	P.C.C. Lined Channel	1,800	824	895	80	85
2050	Unlined Channel	2,121	66	84	85	95
2060	60" RCP	230	44	58	70	--
2065	42" RCP	31	12	12	70	92
2070	42" RCP	144	40	54	70	--
2080	Unlined Channel	750	40	55	70	92
2085	18" RCP	15	4	5	83	92
2090	Detention Facility	74	30	35	85	92
2100	36" CMP	35	60	65	70	--
2101	24" CMP	6	26	31	82	89
2105	30" CMP	30	34	34	83	--
2110	P.C.C. Lined Channel	3,060	681	726	70	93
2120	2-6'x4', 1-8'x4' RCB	1,155	672	709	77	86
2130	P.C.C. Lined Channel	788	641	667	83	--
2140	24" RCP	34	70	70	78	--
2142	18" RCP	17	36	36	83	--
2150	P.C.C. Lined Channel	788	584	615	83	--
2151	18" RCP	18	12	12	83	--
2160	P.C.C. Lined Channel	65	125	127	75	--
2170	24" RCP	32	101	103	83	85
2180	24" RCP	32	89	89	83	--
2190	Unlined Channel	9	51	51	83	--
2200	24" RCP	25	44	44	83	--
2210	Unlined Channel	71	33	33	83	--
2220	15" RCP	10	25	25	83	--
2230	Unlined Channel	907	460	492	72	--
2240	Unlined Channel	667	248	265	72	--
2250	2-2.5'x3.8' RCB	285	234	242	75	--
2260	Unlined Channel	122	219	240	75	78
2270	30" RCP	40	103	103	78	--
2280	Unlined Channel	56	84	84	78	--
2290	24" RCP	20	58	58	78	--
2300	48" RCP	120	105	119	78	--
2310	49"x32" RCPHE	88	96	110	83	87
2320	36" RCP	70	51	60	84	92
2330	Unlined Channel	3,840	270	289	78	--
2340	60" RCP	294	246	258	80	87

Table V-19 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
2350	Detention Facility	79	260	273	87	--
2360	30" RCP	42	15	15	85	--
2370	21" CMP	13	55	71	70	--
2380	Unlined Channel	49	56	73	80	85
2390	18" RCP	15	45	61	77	87
2400	8'x4' RCB	343	288	283	83	--
2410	6'x3.5' RCB	192	280	277	83	--
2420	65"x40" RCPA	170	276	268	83	--
2430	42" RCP	110	138	138	83	--
2432	18" RCP	5	18	18	83	--
2440	42" RCP	110	105	105	83	--
2450	36" RCP	82	86	86	83	--
2460	36" RCP	77	73	73	83	--
2470	30" RCP	54	60	60	88	--
2480	48" CMP	99	135	128	78	--
2485	48" CMP	99	119	115	78	--
2490	48" CMP	103	107	103	78	--
2495	18" CMP	8	11	11	78	--
2500	42" CMP	65	63	58	78	80
2505	36" CMP	55	53	48	78	80
2510	24" RCP	33	43	38	92	85

The model for watershed LS-HIJK includes a total of two detention facilities. Pertinent data on those facilities are summarized in the following table.

Table V-20

WATERSHED LS-HIJK, FUTURE LAND USE
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized Existing 10 Yr. (ac-ft)	Storage Utilized Future 10 Yr. (ac-ft)
2090	Private, Planned	10.58	0.7	0.39	0.43
2350	Private, Recreational	137.70	10	12.77	12.93

15. WATERSHED LS-L

With the completion of future development the majority of this watershed will be classified as industrial and the drainage from 424 acres will be impacted by the land modifications.

Table V-21 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-21

WATERSHED LS-L, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	Unlined Channel	113	773	1,065	70	75
1010	Unlined Channel	88	81	94	72	80
1020	Unlined Channel	81	56	64	75	83
1030	15" RCP	8	38	39	80	87
1040	Unlined Channel	61	34	34	88	--
1045	18" RCP	15	10	10	88	--
1050	Unlined Channel	87	730	1,013	75	85
1060	Unlined Channel	661	30	45	73	86
1070	Unlined Channel	98	343	527	75	90
1080	Unlined Channel	133	320	492	73	82
1090	Unlined Channel	743	294	452	75	90
1100	42" RCP	110	267	405	80	90
1110	Unlined Channel	126	222	352	74	92
1120	Unlined Channel	66	45	72	75	92
1130	Unlined Channel	71	31	42	75	92
1140	Unlined Channel	89	14	14	90	--
1150	Unlined Channel	19	142	220	75	92
1160	Unlined Channel	17	87	143	75	92
1170	24" CMP	17	27	42	75	92
1180	Unlined Channel	494	390	488	77	86
1190	Unlined Channel	482	331	392	75	92
1200	3-42" CMP	260	278	303	78	--
1210	P.C.C. Lined Channel	225	230	257	78	--
1220	6'x4' RCB	301	224	251	83	--
1225	P.C.C. Lined Channel	225	196	222	83	--
1230	P.C.C. Lined Channel	225	193	221	83	--
1240	73"x55" CMPA	166	180	209	83	--
1250	P.C.C. Lined Channel	184	170	197	83	--
1260	27" RCP	28	39	39	78	--
1270	21" RCP	16	17	17	83	--
1280	72"x44" CMPA	76	114	143	70	--
1283	P.C.C. Lined Channel	34	43	57	80	92
1285	21" RCP	17	14	20	80	92
1290	P.C.C. Lined Channel	127	70	84	83	85
1300	24" RCP	16	67	80	83	92
2000	Unlined Channel	51	78	119	73	83
2010	15" RCP	7	46	74	75	92
3000	Unlined Channel	42	70	105	75	92

16. WATERSHED LS-MNOP

Future land use modifications will change the classification of approximately half of the residential areas from low to medium density and will add commercial and light industrial areas along the highway. These changes will impact the drainage from 168 acres within the corporate limits although to a relatively small degree.

Table V-22 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-22

WATERSHED LS-MNOP, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	36" RCP	77	360	372	83	--
1005	36" RCP	77	349	355	83	--
1010	36" RCP	77	330	336	83	--
1020	36" RCP	77	307	321	83	--
1030	36" RCP	77	284	299	83	--
1040	36" RCP	77	265	276	83	--
1045	36" RCP	79	254	265	83	84
1050	36" RCP	79	232	244	83	86
1060	36" RCP	97	215	220	83	85
1070	30" RCP	60	179	186	83	85
1080	30" RCP	53	151	153	83	85
1090	27" RCP	42	117	123	83	85
1100	27" RCP	43	86	87	83	86
1110	24" RCP	34	71	68	83	--
1120	21" RCP	27	37	38	83	84
2000	30" RCP	53	43	54	83	95
2010	24" RCP	34	43	51	83	95
2015	24" RCP	34	40	48	75	87
2020	24" RCP	31	34	38	75	87
2025	24" RCP	31	24	26	83	87
2030	24" RCP	31	13	15	83	87
2040	24" RCP	31	6	6	83	87
3000	4'x3' RCB	136	157	181	75	92
3010	48" RCP	150	145	158	75	92
3020	48" RCP	188	130	137	75	92
3025	24" RCP	47	27	30	83	87
3030	48" RCP	144	102	105	83	87
3040	48" RCP	144	88	89	70	--
3050	Unlined Channel	586	89	90	83	87
3060	4.5'x3' RCB	144	68	68	75	--

Table V-22 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
4000	24" RCP	47	42	57	88	--
4005	21" RCP	23	36	50	88	--
4010	21" RCP	21	31	46	88	91
4020	18" RCP	9	14	17	83	90
4030	Unlined Channel	77	13	23	70	92
4040	18" CMP	8	10	19	70	92
5000	18" CMP	7	37	48	75	91
5010	Unlined Channel	75	34	45	75	95
5020	15" CMP	4	21	24	83	87
6000	24" CMP	16	86	88	88	95
6010	24" CMP	16	86	87	80	91
6020	Unlined Channel	100	79	79	70	--
6030	18" RCP	15	3	3	83	--
6040	30" RCP	49	78	78	83	--

17. WATERSHED LS-Q

This watershed is fully developed, almost exclusively in single family or low density, residential development. A small amount of future land use modification affects the drainage of only 17 acres of this area.

Table V-23 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-23

WATERSHED LS-Q, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	81"x59" CMPA	363	361	369	83	--
1010	18" CMP	9	11	11	83	--
1020	18" CMP	8	20	20	83	--
1030	P.C.C. Lined Channel	232	339	345	83	--
1035	21" CMP	13	24	24	83	--
1040	18" CMP	8	8	8	83	--
1050	P.C.C. Lined Channel	267	309	316	83	--
1060	24" CMP	14	20	20	83	--
1070	24" CMP	14	24	24	83	--
1080	P.C.C. Lined Channel	214	266	274	83	--
1090	81"x59" CMPA	133	263	272	83	--
1100	30" RCP	29	23	23	83	--
1110	P.C.C. Lined Channel	159	236	243	83	--

Table V-23 (continued)

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1115	P.C.C. Lined Channel	154	216	224	78	83
1118	P.C.C. Lined Channel	200	159	159	85	--
1119	24" CMP	18	15	18	76	83
1120	27" RCP	34	25	25	83	--
1130	15" RCP	8	20	20	83	--
1140	Unlined Channel	20	45	45	79	--
1150	42" RCP	73	27	27	70	--
1160	30" RCP	30	21	21	83	--
1170	30" RCP	55	6	6	83	--
1180	P.C.C. Lined Channel	240	111	111	79	--
1190	48" CMP	105	99	99	83	--
1200	42" CMP	63	82	82	83	--
1204	36" CMP	55	73	73	83	--
1208	24" CMP	17	19	19	83	--
1210	30" CMP	34	33	33	83	--
1220	24" CMP	20	25	25	83	--
2100	36" RCP	60	44	44	83	--
2110	36" RCP	67	39	39	83	--
2120	30" RCP	49	28	28	83	--
2130	30" RCP	46	16	16	83	--
3000	36" RCP	76	63	63	83	--
3005	36" RCP	67	48	48	83	--
3010	21" RCP	22	34	34	83	--
3015	15" RCP	9	8	8	83	--
3020	21" RCP	22	16	16	83	--
3030	24" RCP	41	2	2	83	--
4000	30" RCP	37	45	45	83	--
4010	24" RCP	23	28	28	83	--
5000	42" RCP	109	84	84	83	--
5005	36" RCP	60	81	81	83	--
5010	36" RCP	60	59	59	83	--
5020	36" RCP	100	53	53	83	--
5025	21" RCP	22	19	19	83	--
5030	30" RCP	44	21	21	83	--
5040	24" RCP	31	13	13	83	--

18. WATERSHED OC-A

With future development this watershed will be primarily a mixture of low, medium and density residential areas. This land development will impact the drainage from 439 acres of the watershed.

Table V-24 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-24

WATERSHED OC-A, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
1000	Unlined Channel	1,433	2,482	2,763	70	85
1010	Unlined Channel	343	33	36	70	--
1020	Unlined Channel	166	21	25	70	74
1030	Unlined Channel	1,106	2,731	2,850	70	--
1040	Unlined Channel	19	294	378	70	75
1050	Unlined Channel	2,462	2,776	2,969	70	--
1060	24" CMP	23	30	28	83	79
1070	Unlined Channel	834	254	290	75	--
1080	42" CMP	67	86	83	83	79
1090	36" CMP	56	75	74	83	--
1100	36" CMP	61	72	71	83	--
1110	18" CMP	10	18	15	83	77
1120	30" CMP	36	48	49	83	80
1130	21" CMP	23	21	22	75	77
1140	24" CMP	20	25	25	83	--
1149	27" CMP	25	169	210	70	--
1150	Unlined Channel	231	173	211	78	83
1160	60" CMP	164	145	179	80	83
1170	54" CMP	131	112	142	75	83
1175	24" CMP	19	99	127	75	83
1180	36" CMP	56	76	95	75	82
1185	30" CMP	44	57	72	75	82
1190	42" CMP	95	34	42	75	83
1200	Unlined Channel	603	2,850	3,049	75	79
1210	P.C.C. Lined Channel	143	207	329	75	83
1215	18" RCP	5	9	9	83	--
1220	Unlined Channel	1,246	210	320	75	78
1230	6'x4' RCB	360	198	204	70	--
1240	24" CMP	22	22	27	79	87
1250	Unlined Channel	346	183	286	75	87
1260	72" CMP	283	175	272	83	88
1265	66" CMP	224	173	270	70	90
1270	Unlined Channel	88	160	251	70	85
1280	Unlined Channel	43	104	153	73	85
1290	Detention Facility	18	5	7	75	83
1300	Unlined Channel	4,065	2,816	3,047	80	85
1320	Unlined Channel	132	17	21	70	80
1330	6'x4' RCB	318	7	7	82	--
1340	Unlined Channel	1,082	2,870	3,079	70	84
1350	Unlined Channel	117	90	145	70	88
1360	Unlined Channel	108	67	115	70	86
1370	Unlined Channel	2,176	2,925	3,148	70	89

The model for Watershed OC-A includes a total of one detention facility. Pertinent data on that facility are summarized in the following table.

Table V-25

WATERSHED OC-A, FUTURE LAND USE
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized Existing 10 Yr. (ac-ft)	Storage Utilized Future 10 Yr. (ac-ft)
1290	Private, Agricultural	14.93	4	1.59	2.05

19. WATERSHED OC-B

Future development includes only low and medium residential areas which will impact the drainage from approximately 118 acres of the watershed.

Table V-26 indicates the specific hydraulic capacity of each modelled reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-26

WATERSHED OC-B, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
2000	8'x8.5' RCB	1,020	328	413	80	--
2010	11'x12.5' Bridge	1,577	324	412	83	--
2020	Unlined Channel	89	295	384	78	80
2025	Unlined Channel	495	268	358	78	--
2030	30" CMP	49	17	20	78	85
2040	15" RCP	12	14	14	83	--
2050	P.C.C. Lined Channel	450	234	321	75	85
2060	18" RCP	18	14	14	83	--
2070	24" CMP	35	18	18	83	--
2080	Unlined Channel	152	202	273	73	85
2090	Unlined Channel	125	33	33	70	--
2095	18" CMP	10	33	33	83	--
2100	Unlined Channel	252	158	233	72	83
2110	Unlined Channel	70	107	155	72	83

20. WATERSHED OC-C

Future development withion this watershed is projected to be primarily low density residential. Within the corporate limits, the drainage of 663 acres will be impacted by this future land use modification.

Table V-27 indicates the specific hydraulic capacity of each reach and compares the existing and future 10-year demand discharges and curve numbers.

Table V-27

WATERSHED OC-C, FUTURE LAND USE
LINE PERFORMANCE SUMMARY

Line No.	Line Description	Line Capacity (cfs)	Demand Discharge Existing 10 Yr. (cfs)	Demand Discharge Future 10 Yr. (cfs)	Curve Numbers Existing	Curve Numbers Future
3000	Unlined Channel	322	117	184	70	83
3010	Unlined Channel	394	62	102	70	84
3020	Detention Facility	106	41	70	80	--
3030	Detention Facility	106	113	375	85	--
3040	Unlined Channel	105	78	118	70	83
3050	Unlined Channel	37	90	148	70	87
3060	4'x2' RCB	98	85	142	70	86
3070	Unlined Channel	280	84	158	70	91
3080	2'x1.5' RCB	30	27	49	70	90
3100	Unlined Channel	899	3,014	3,169	70	80
3110	Unlined Channel	1,137	3,007	3,153	70	80
3115	Unlined Channel	264	325	483	70	81
3120	Unlined Channel	235	283	437	70	80
3130	Unlined Channel	92	116	183	70	83
3140	Unlined Channel	95	18	29	70	83
3150	Unlined Channel	208	86	133	70	83
3160	Unlined Channel	68	133	202	70	80
3170	Unlined Channel	84	106	165	70	81
3180	Unlined Channel	96	56	89	70	83
3190	Unlined Channel	665	3,014	3,160	70	79
3200	Unlined Channel	815	3,028	3,160	70	78
3210	Unlined Channel	815	3,123	3,245	70	83
3220	Unlined Channel	815	3,153	3,162	70	81

The model for Watershed OC-C includes a total of two detention facilities. Pertinent data on those facilities are summarized in the following table.

Table V-29

WATERSHED OC-C, FUTURE LAND USE
DETENTION FACILITIES SUMMARY

Line No.	Type	Drainage Area (ac)	Maximum Storage (ac-ft)	Storage Utilized Existing 10 Yr. (ac-ft)	Storage Utilized Future 10 Yr. (ac-ft)
3020	Private, Agricultural	185.01	30	14.90	21.33
3030	Private, Agricultural	150.31	12	11.17	11.94

VI – SYSTEM IMPROVEMENT ALTERNATIVES

PART VI

SYSTEM IMPROVEMENTS ALTERNATIVES

A. ALTERNATIVE SYSTEM COMPONENTS

1. GENERAL

There are two different basic types of system components. They are "structural" and "nonstructural" elements. All must be operated in a complementary way to avoid drainage "problems." Each element of the system has a cost associated with providing it. The goal of this master plan is to recommend the best balanced combination of all system elements that will provide the desired level of service at the greatest economic benefit to the City as a whole. Possible alternative system components are described below.

2. NONSTRUCTURAL ELEMENTS

Nonstructural elements of a drainage system are generally those elements that don't involve significant capital construction, but function as a part of the system by limiting runoff. Their "cost" is primarily measured by generally lowered tax revenue and economic activity, although some direct maintenance cost often applies to their continued performance. Once they become part of the "system," they can't readily be modified because their modification will increase runoff to the entire downstream system reducing its level of service. Nonstructural elements are:

a. Zoning and Land Use

Zoning ordinances prescribe types of land use and density of development. Dense land use, such as commercial development, generates high runoff rates. Residential land use generates relatively low runoff rates. Small lots will generate more runoff than large lots, etc. The "cost" of zoning with respect to drainage is in that the "highest and best use" of land in real estate vernacular produces the greatest tax revenue. Down-zoning to reduce runoff and the associated cost of the downstream system reduces that potential revenue.

b. Flowage Easements

Flowage easements involve the acquisition of the right to periodically use a natural channel and its overbank floodway to convey drainage. In a sense, they represent a form of limited conservation zoning in that they preclude any improvement of the land occupied by the easement. Flowage easements follow the natural ephemeral waterway and vary in width to include all land below the elevation of the design hydraulic gradient plus a freeboard allowance. Easement widths in the range of 50 to 100 feet are representative. Natural channels and their overbank areas require little initial construction, but must be inspected and maintained on a regular basis to remove obstructing debris and snags.

c. Regulatory Detention

Regulatory detention is the adoption of appropriate ordinances and implementation of regulations that, while permitting intense land uses, require the provision, operation, and maintenance of on-site detention facilities to limit the peak rate of discharge from the owner's (developer's) site to the downstream system. They require no direct capital investment by the City but have the effect of either diminishing the net developable land by the area required for detention or requiring more costly structures as part of the development. They are most effective when physically located at the upper end of watersheds.

d. Removal of Improvements

The purchase, demolition, and removal of structures subject to damage from drainage is a viable method of providing drainage service to the City as a whole. Drainage "problems" are the damage and/or extreme nuisance resulting from the flow of storm water on private and public property. Removal of the affected improvement is a viable choice in cases where the cost of removing the water is disproportionately large compared with the value of the improvement.

3. STRUCTURAL ELEMENTS

Structural elements of a drainage system are those designed to collect and convey runoff. They include structures that require a significant

capital investment to build, and will depreciate over a long period of time. Structural components of the system are:

a. Conveyance Facilities

Conveyance facilities are the conventional structures such as:

- o Pipes.
- o Inlets.
- o Culverts.
- o Bridges.
- o Lined open channels.
- o Natural open channels.

b. Detention Facilities

Detention facilities are ponds, dry ponds, and functionally similar structures constructed with controlled service and emergency spillways that are operated by the City to reduce the peak rate of flow in the drainage system. Land enclosed by some may be capable of other beneficial uses such as open parks and buffer zones between different land use areas. The construction cost of the facility is often moderate when compared with alternative structural conveyance facilities. Because they are functionally most effective when located near the upper reaches of watersheds, the land occupied is valuable, and its acquisition forms a large part of the cost of their development. They require regular maintenance in the form of mowing and periodic removal of the sediment trapped by the facility.

B. COMPARISON OF ALTERNATIVES

Table VI-1 presents a qualitative comparison of the performance and cost impact typical of the alternative system components.

TABLE VI-1
COMPARISON OF ALTERNATIVES

System Component	Land Area Required	Land Value	Tax Base Effect	Regular Maint. Required	Capital Cost	Depr.
Nonstructural						
Downzoning	None	High	Negative	None	None	None
Flowage Easements	High	Low	None	High	None	None
Regulatory Detention	Moderate	High	Slight	None	None	None
Removal of Improvements	Moderate	High	Negative	None	None	None
Structural						
Enclosed Pipe/Culvert	Low	None	None	Moderate	High	High
Lined Open Channels	Moderate	None	None	Moderate	Moderate	High
Municipal Detention Basins	High	High	Slight	High	Moderate	Low

C. EVALUATION OF ALTERNATIVES

1. ZONING AND LAND USE

There are currently substantial undeveloped areas in the City that are zoned for relatively intense future land uses which will increase runoff in their respective watersheds. However, many of the drainage system elements downstream from these areas are undersized now for existing land use conditions. In many cases, relatively minor additional capital costs are associated with the cost of providing the necessary larger capacity drainage facilities for future development. The potential general economic benefits expected to accrue by development as zoned

exceed the cost of providing drainage service. Therefore, no zoning changes are considered as part of the Storm Drainage Master Plan.

2. FLOWAGE EASEMENTS

In essence, flowage easements have been incorporated into the City's Comprehensive Land Use Plan as evidenced by the "open" land use classification along many of the existing natural channels included in the drainage system. Using the information from the Comprehensive Plan, the Storm Drainage Master Plan also is based on obtaining these flowage easements. We recommend the City proceed with reserving the land and rights of maintenance for these areas to preserve the functional performance of the drainage system.

3. REGULATORY DETENTION

The use of regulatory detention as a planned portion of the system was applied in but limited instances more fully described in Part VIII; however, there are several undeveloped areas where its use may appreciably modify the need for structural elements of the system. We recommend that the City adopt provisions for the optional requirement of on-site detention to provide the ability to control drainage should the demand for development precede the City's construction schedule for downstream improvements.

4. REMOVAL OF IMPROVEMENTS

This alternative was not utilized in the Master Plan. No existing structures or drainage elements were indicated to suffer damage to the

extent that removal was a more attractive option than improvement of the drainage system. However, this alternative may still be viable when developing detailed plans for a specific project and should be considered on a case-by-case basis.

5. CONVEYANCE FACILITIES

The majority of the recommended system improvements involve enlarged or modified conveyance facilities, typically through replacement of existing facilities with larger pipes or box culverts. Open channels were retained in the system where practicable. Information on specific criteria for the use of various types of conveyance facilities is presented in Part VII of this report.

6. PUBLIC DETENTION FACILITIES

Potential locations for public detention facilities are available in several of the undeveloped watersheds. However, by including detention facilities as part of the major system, the drainage system can, in effect, limit future development. Land required for a basin is no longer available for development. Sizing other downstream drainage elements for flows reduced by detention may not allow future flexibility in omitting a basin from the system without providing additional downstream improvement. In addition, a detention facility imposes a special obligation on its Owner to use every reasonable measure to reduce the risk of the sudden release of impounded water by failure of the dam, especially when the hydraulic load exceeds design capacity. Care must be taken in selecting a site to minimize the risk of damage,

if failure does occur. The initial cost of construction, typically high-maintenance costs, and potential liabilities associated with substantial detention facilities make this an unattractive option unless substantial investment in the downstream system may be avoided through use of the detention. Such potential was not identified at any location within the City; therefore, no new detention facilities are included in the overall plan of improvement.

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VII – IMPROVEMENT CRITERIA

PART VII

IMPROVEMENT CRITERIA

A. GENERAL

Current criteria adopted by the City of Grandview for the design of improvements to the storm drainage system requires adherence to SECTION 5600, "Storm Drainage Systems and Facilities" of the Standard Specifications and Design Criteria adopted October 26, 1983 by the Kansas City Metropolitan Chapter of the American Public Works Association. Accordingly, all anticipated improvements to the storm drainage system are modelled on the basis that the specific design of those improvements will be in accordance with that criteria.

1. APPLICATION TO ENCLOSED SYSTEMS AND CULVERTS

Section 5604.3 of the APWA criteria requires that, when multiple land use/zoning classifications are tributary to any system component, that component shall be designed on the basis of a composite return frequency weighted in direct proportion to the respective portion of the tributary area represented by each land use. This requirement primarily affects enclosed systems and roadway culverts, as the design return frequency for open channels does not vary with land use classification.

However, the suggested methodology in the APWA criteria does not readily lend itself to application on a city-wide analysis. It is, therefore, necessary to adjust the methodology to more directly incorporate data

available from the system models, and to facilitate the application of numerical methods to the evaluation and selection of improvements.

The APWA criteria requires the application of greater return periods for land uses with higher percentages of impervious areas. One direct measurement of the relative composition of land uses in the total area tributary to a given system component is the composite SCS curve number which is directly generated by the system model.

Review of the existing condition demand discharges presented in Part IV of this report reveals that the peak discharge during a 25-year event varies from 120 percent to 132 percent of the peak discharge during the 10-year event. On a generalized basis, assignment of 125 percent of the peak 10-year discharge as representative of the peak discharge during a 25-year event will closely approximate the modelled 25-year discharge.

Improvements to roadway culverts and enclosed systems identified in this report consider a design capacity keyed to the composite SCS curve number and to the peak 10-year discharge as an index in accordance with the following.

TABLE VII-1
ENCLOSED SYSTEMS AND CULVERTS
DESIGN CAPACITY INDEX

Composite SCS Curve Number	Design Capacity in % of Future Peak 10-Year Discharge
≤83	100
84	102.5
85	105.0
86	107.5
87	110.0
88	112.5
89	115.0
90	117.5
91	120.0
92	122.5
≥93	125.0

B. IDENTIFICATION OF IMPROVEMENT LOCATIONS

The following is a summary of criteria employed in the identification of those elements of the drainage system for which improvement, whether publicly or privately financed, is recommended. All analyses are based on demand discharges projected to occur upon complete development of the various tributary areas as contemplated by the City's Comprehensive Land Use Plan, and implementation of regulatory detention facilities recommended in this report.

1. EXISTING IMPROVED ELEMENTS

Section 5601.4 of the APWA criteria provides that existing drainage system components may be retained as elements of an improved system if their hydraulic capacity is not less than 80 percent of the required design capacity. This general criteria provides a basis for an initial screening of all existing enclosed systems, roadway culverts, and lined open channels represented in the system models. This permissive

criteria, when coupled with the design capacity index presented in Table VII-1, results in the following screening index.

TABLE VII-2
EXISTING IMPROVED COMPONENTS
IMPROVEMENT SCREENING INDEX

Component Type	Composite SCS Curve Number	Capacity in % of Future Peak 10-Year Discharge
Enclosed System or Culvert	≤83	80.0
	84	82.0
	85	84.0
	86	86.0
	87	88.0
	88	90.0
	89	92.0
	90	94.0
	91	96.0
	92	98.0
	≥93	100.0
Lined Channel	---	100.0

A system component whose capacity equals or exceeds that in the above tabulation is excluded from consideration for improvement.

The failure of an existing improved element to meet the criteria established above does not necessarily mean that it should be replaced. Elements which do not meet the above criteria are subjected to a second screening prior to a recommendation for replacement. This second screening considers the impact resulting from the deficient hydraulic capacity, weighing the real need for replacement against the expenditure of public funds for that purpose. The nature of this second screening varies with type of improvement.

a. Enclosed Systems

Enclosed systems are separated into two general categories. The first category consists of enclosed systems within street rights-of-way. The second consists of enclosed systems in developed rear and side yard locations.

(1) In Street Rights-of-Way: The total capacity of an enclosed system within street right-of-way consists of a combination of the hydraulic capacity of the pipe and the hydraulic capacity of the street curb or roadside ditch. Hydraulic deficiencies in the combined capacity of the two result in interruption of the flow of traffic, inconveniencing the traveling public and restricting the movement of emergency vehicles.

These enclosed facilities are not considered for replacement unless the line capacity is more than 15 cfs less than the future 10-year peak discharge as identified in PART V of this report. For two-lane curbed roadways, this allowance of 15 cfs is equivalent to curb-full flow along both curbs at a longitudinal gradient of 0.5 percent, and fully complies with APWA allowable spread criteria for longitudinal slopes of 6 percent and greater. For curbed roadways with more than two lanes, and curb flow considered restricted to one side, the spread is 19 feet at a longitudinal gradient of 0.5 percent.

(2) In Rear and Side Yards: In rear and side yards, the total capacity consists of the combined capacity of the line and any overflow channel or swale along or parallel to the line. The consequences of a deficiency in the hydraulic capacity of the line consists initially of the risk of erosion or damage to yard facilities, increasing to the possibility of structural damage in extreme cases.

Since APWA criteria does not specifically address this situation in existing systems, the following basic assumptions are necessary to provide a basis for identifying reaches for improvement.

- o A typical yard swale is 4 feet wide with side slopes of 6 horizontal to 1 vertical.
- o The average longitudinal slope of the swale is 2 percent.
- o Flow velocities are limited to 3-7 fps.
- o Maximum allowable depth of flow at the future 10-year discharge is 6 inches.

Using these parameters, a swale flow of 15 cfs (at a velocity of approximately 5 fps) is determined. Therefore, existing facilities in side and rear yard locations are not considered for improvement unless the future 10-year peak discharge exceeds the existing line capacity by more than 15 cfs.

(3) Other Locations: In a few cases, enclosed systems are located under private parking areas or even beneath buildings and do not really fit either of the other two general categories with improvement criteria. In these instances, the reaches were not improved unless actual damage was known to occur or indicated by the model.

b. Culverts

Hydraulic deficiencies in cross-road culverts generally result in the excess flow overtopping the roadway. Depending on the magnitude of the deficiency, the impact can vary from a minor inconvenience to total closure of a road to traffic. Identification of culverts for replacement generally is based on the screening index presented in Table VII-2. The major exceptions are those culverts under U.S. Highway 71 and its access roads. Culverts directly beneath the highway are not considered for replacement under any conditions since realistically any deficiencies will not impact the highway itself. Culverts beneath the access roads are not considered for replacement unless upstream development and other improvements result in a future 10-year peak discharge at the access road considerably higher than existing flows which would result in inundation of the road and/or surrounding areas.

Other exceptions include culverts on private property and undeveloped areas. Culverts under private drives or roads were not

considered for replacement unless they significantly impacted the development of other public improvements or the future peak discharge was substantially greater than existing flows. A few culverts in substantially undeveloped areas were also not included in the proposed improvements if the future location and configuration of roads and other improvements could not realistically be discerned at this point in time. A more accurate estimation of required improvements in these areas and the associated costs can be made when more detailed development plans are available.

c. Open Channels

Open channels are also divided into two general categories, improved and unimproved. For the most part, improved channels include those constructed with some type of lining material such as concrete, riprap, or turf and are generally limited to developed areas. Unimproved channels are primarily existing natural channels in undeveloped areas.

APWA design criteria require all new open channels to be sized for the 25-year discharge. However, in identifying existing channels of either type for improvement, it is important to consider the combined capacity of both the channel and the overbank floodway in evaluating performance. The capacities identified in the drainage system models are based on the defined channel sections where normal flows occur. During periods of peak discharge, flows may also be

conveyed in the overbank portion of the channel. In many cases, periodic overflows of the defined channels are expected and may or may not indicate the need for improvement depending on the actual effects of the overflow.

(1) Improved Channels: As indicated in Table VII-2, improved channels having capacities equal to or greater than the future 10-year peak discharges are not considered further for improvement. In these cases, the 25-year discharge may result in some overflow but it will be contained well within the limits of the defined floodway. For those reaches not meeting this criterion, an individual review must be made since overbank configuration and proximity to structures vary for each one.

To assess the need for improvement, the maximum depth of flow projected for the future 25-year discharge is compared to the maximum allowable depth in the combined channel and floodway before structural damage will occur. If the flow depth is less than the allowable depth, no improvement is necessary. If flooding of a structure is indicated, improvement of that reach is required.

(2) Unimproved Channels: For unimproved channels, the initial screening is based on future land use designations. Channels located in areas designated as "open" in the City's Comprehensive Land Use Plan are not considered further for any

type of improvement. Unimproved channels in currently developed areas, or areas projected to be developed in the future, are also excluded from the recommended improvements if one or more of the following criteria are met:

- The capacity of the channel section itself is at least 125 percent of the future 10-year peak discharge.
- No damage to existing structures or improvements currently occurs or will occur in the future based on a comparison of the projected 25-year depth of flow and the allowable depth of flow.
- Improvement of the channel will have little or no effect on other downstream reaches that are being recommended for replacement; i.e. whether or not the channel is improved will not change the recommendations for other improvements.
- Topography around the channel is such that future development immediately adjacent to it is highly unlikely, in essence leaving additional "open" area along the channel.

Unimproved channels that are not excluded by the above criteria are included in the recommended improvements.

* * * * *

VIII – PROPOSED IMPROVEMENTS

PART VIII

PROPOSED IMPROVEMENTS

A. GENERAL

This section presents a summary of the proposed improvements to the existing storm drainage system necessary to provide an acceptable level of service under future land use conditions. Under this proposed plan all reaches of the existing drainage system identified as undersized and meeting the criteria for improvement are replaced with new conveyance facilities. Conveyance facilities are the conventional structures in a drainage system such as pipes, culverts, bridges and lined or natural channels. Existing planned detention facilities in currently developed areas are retained in the system without improvement or change. Existing unplanned detention facilities in undeveloped areas are replaced with conveyance elements. No new public detention facility of any type is included in this plan.

B. SUMMARY OF COSTS

The estimated total capital costs for improvement of the existing major drainage system throughout the City of Grandview are summarized below by watershed. These are the costs considered to be the City's financial responsibility and do not include any estimates of improvements made by private owners or developers in the future. Costs are expressed in 1988 dollars.

Watershed	Capital Cost ($)
B-A	$ 608,100
B-B	922,400
B-CD	222,000
B-E	83,200
LN-A	387,200
LN-BC	1,453,200
LN-DE	1,189,900
LN-F	230,600
LS-AB	430,600
LS-C	400,000
LS-D	1,492,200
LS-EF	2,016,200
LS-G	48,100
LS-HIJK	638,500
LS-L	418,900
LS-MNOP	2,431,900
LS-Q	143,600
OC-A	0
OC-B	22,100
OC-C	0
City Total	$13,138,700

C. PLAN DEVELOPMENT

For purposes of plan development, the following principles were generally applied.

- All new facilities were sized to completely convey the future 10-year discharge without utilizing overflow channels.
- An enclosed element (pipe or box culvert) was used if the future 10-year peak discharge was less than 135 cfs or if the line location was limited by structures or other improvements. (A study of cost vs. discharge indicates that below approximately 135 cfs an enclosed system generally is less costly while above 135 cfs an open channel is less expensive.)
- For future 10-year peak discharges of 135 to 1000 cfs, concrete lined open channels were used where structure location was not a constraint.

- o For peak discharges greater than 1000 cfs, unimproved channels were used wherever practicable.
- o Existing facilities were replaced with new ones, rather than paralleled, in nearly all cases. In cases of relatively new lines, however, parallel facilities were included.
- o New facilities were assumed to follow existing alignments.
- o New line size was limited to the vertical dimension of the existing line plus 6 inches to minimize potential utility conflicts and maintain required cover in the cases of many road culverts. Box culverts were used when the required size of round pipes exceeded this constraint.
- o Manning's "N" = 0.013 was used for new lines and concrete lined channels.
- o The slopes of new lines were assumed to be equal to existing slopes.

D. WATERSHED SUMMARIES

The following sections provide additional detail on the proposed improvements in each watershed with specific descriptions of the individual lines for comparison. Descriptions of the existing facilities are contained in Parts IV and V of this report.

Cost estimates and priority numbers for those lines that will be the City's financial responsibility to replace are presented. The City is assumed to be financially responsible for all existing conveyance facilities that were dedicated to the City in previously developed areas and for such elements as existing public road culverts in areas that will otherwise be developed in the future. Costs for improvements which are the responsibility of future developers, private owners or other governmental agencies are not included.

Capital costs indicated for the improvements include land acquisition (where applicable), professional services and construction. Priorities are indicated for all lines except road culverts which do not cause any type of damage when capacities are exceeded. Specific information on prioritization is included in Part IX of this report.

1. WATERSHED B-A

Currently, watershed B-A is largely undeveloped but will eventually be classified as light industrial or industrial distribution. Of the 53 identified existing major drainage system elements, 23 meet the established criteria for improvement. The two existing private detention facilities in the watershed, Reaches 1010 and 2060, remain in the system unchanged. Table VIII-1 describes each proposed improvement and compares the hydraulic capacity to future 10-year demand discharge for each modelled reach.

Table VIII-1

WATERSHED B-A, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1050	30" RCP	58	35
1060	P.C.C. Lined Channel	720	679
1070	21' x 3' RCB	793	667
1080	P.C.C. Lined Channel	720	671
1090	3' x 4' RCB	179	142
1100	4.5' x 2.5' RCB	169	120
1110	36" RCP	99	71
1120	5.5' x 2' RCB	85	70
1130	P.C.C. Lined Channel	720	462
1140	36" RCP	94	59
1150	30" RCP	58	38
1160	P.C.C. Lined Channel	720	368
1180	3.5' x 2' RCB	63	51
1200	27" RCP	34	26
*1260	12' x 2' RCB	202	173
1290	P.C.C. Lined Channel	211	148
1300	6.5' x 3' RCB	143	127
1310	3' x 3.5' RCB	89	80
1320	3.5' x 2' RCB	67	56
1340	30" RCP	47	40
2000	4.5' x 3' RCB	192	152
2050	3.5' x 2.5' RCB	74	55
3000	2.5' x 2' RCB	50	35

*Add 4'x2' RCB adjacent to existing 8'x2'.

Thirteen of the proposed improvements are identified as the City's financial responsibility. Of the other lines, three are culverts located on the Burlington or Kansas City Southern (K.C.S.) Railroad's rights-of-way and are considered to be the railroads' responsibility. The remaining reaches are considered developers' obligations. Table VIII-2 summarizes the estimated capital costs for each of the City's lines as well as priority numbers for lines other than road culverts.

Table VIII-2

WATERSHED B-A, COST ESTIMATES AND PRIORITIES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1110	76,200	25
1120	22,300	N/A
1180	18,200	N/A
1200	9,100	N/A
1260	15,800	N/A
1290	52,700	46
1300	122,500	46
1310	112,900	46
1320	99,900	46
1340	9,100	N/A
2000	22,400	N/A
2050	27,500	N/A
3000	19,500	N/A
Total Cost	$608,100	

2. WATERSHED B-B

Large areas of this watershed are presently undeveloped and will remain undeveloped due to topographic constraints. Future developed areas will be a mixture of residential and light industrial areas.

Although a substantial portion of this watershed will be left undeveloped, 10 of the 37 reaches in the existing major drainage system meet the criteria for improvement. The two existing private detention facilities, Reaches 1060 and 1090, remain in the system unchanged. Table VIII-3 describes each proposed improvement and compares the hydraulic capacity to future 10-year demand discharge for each modelled reach.

Table VIII-3

WATERSHED B-B, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1100	5.5' x 2.5' RCB	146	119
1150	6' x 2.5' RCB	101	75
1170	P.C.C. Lined Channel	338	51
*1175	30: RCP	41	25
1230	2.5' x 1.5' RCB	41	27
1260	6' x 4.5' RCB	405	355
1270	P.C.C. Lined Channel	450	352
1310	5.5'x4' RCB	371	258
1340	5.5' x 4' RCB	214	178
1350	5.5' x 3.5' RCB	184	147
1370	4.5' x 3' RCB	131	109

*A part of existing line 1170.

All but one of the proposed improvements are identified as the City's financial responsibility. Line 1100 is a culvert located under a private road and the owner is considered responsible for any improvement to it. Table VIII-4 summarizes the estimated capital costs for each of the City's lines as well as priority numbers for lines other than road culverts.

Table VIII-4

WATERSHED B-B, COST ESTIMATES AND PRIORITIES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1150	$277,200	24
1170	107,000	24
1175	42,300	24
1230	17,100	N/A
1260	32,200	N/A
1270	116,800	5
1310	109,700	50
1340	98,900	15
1350	*	N/A
1370	121,200	15
Total Cost	$922,400	

*Improved by City subsequent to existing capacity determination.

3. WATERSHED B-CD

Watershed B-CD is currently largely undeveloped. The largest portion of the area will be developed eventually for industrial purposes.

Of the 52 identified elements in the existing major drainage system of this watershed, 20 meet the criteria for improvement. The three existing private, planned detention facilities, Reaches 1150, 1160 and 1260, remain in the system unchanged. The two unplanned detention areas, Lines 1214 and 1230, are included in the proposed improvements. Table VIII-5 describes each proposed improvement and compares the hydraulic capacity to future 10-year demand discharge for each modelled reach.

Table VIII-5

WATERSHED B-CD, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1049	5' x 2' RCB	70	52
1090	8' x 3' RCB	231	192
1100	P.C.C. Lined Channel	240	193
1110	P.C.C. Lined Channel	158	102
1130	20' x 3' RCB	366	316
1190	18" RCP	37	23
1210	25' x 3' RCB	692	470
1212	P.C.C. Lined Channel	240	169
1214	36" RCP	94	78
1220	P.C.C. Lined Channel	158	156
1230	48" RCP	170	117
1240	P.C.C. Lined Channel	158	149
2000	22.5' x 3' RCB	604	564
2070	5.5' x 4' RCB	240	231
2080	6.5' x 4' RCB	203	200
2105	3.5' x 2' RCB	60	48
2110	9.5' x 2' RCB	160	133
*2130	54" RCP	124	96
2150	42" RCP	123	77
2160	36" RCP	82	49

*Replace 24" RCP in street ROW with 36" RCP and leave existing 36" RCP on private property for combined capacity equivalent to 54" RCP.

Only 8 of the 20 proposed improvements, all of which are read culverts are identified as the City's financial responsibility. Four of the other 12 reaches are culverts in Kansas City Southern Railroad's right-of-way, three are located on private property and the remaining five are part of future development. Table VIII-6 summarizes the estimated capital costs for each of the City's lines. No priorities are indicated since none have been assigned to road culverts.

Table VIII-6

WATERSHED B-CD, COST ESTIMATES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)
1049	$ 16,600
1090	23,000
1190	8,300
1210	74,600
2000	49,500
2105	17,100
2110	21,200
2130	11,700
Total Cost	$222,000

4. WATERSHED B-E

Currently watershed B-E is almost totally undeveloped. Eventually, future development in the area will be for industrial uses.

There are 18 elements identified as the existing major drainage system in this watershed. Of these, ten meet the criteria for improvement. One of the three existing detention facilities, Reach 3010, will remain in the system unchanged. The others, Reaches 2020 and 2030, are included in the proposed improvements. Table VIII-7 describes each proposed improvement and compares the hydraulic capacity to future 10-year demand discharge for each modelled reach.

Table VIII-7

WATERSHED B-E, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1010	6' x 7' RCB	539	386
1020	P.C.C. Lined Channel	450	315
1030	P.C.C. Lined Channel	338	225
1040	36" RCP	90	55
2010	13' x 2' RCB	179	142
2015	P.C.C. Lined Channel	145	116
2020	48" RCP	144	104
2030	42" RCP	123	81
3050	24" RCP	32	28
3060	7' x 2' RCB	170	142

Only four of the proposed improvements, all of which are road culverts, are identified as the City's financial responsibility. The other six are the future developers' responsibilities. Table VIII-8 summarizes the estimated capital costs for each of the City's lines. No priorities are indicated since none have been assigned to road culverts.

Table VIII-8

WATERSHED B-E, COST ESTIMATES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)
1010	$26,600
2010	29,800
3050	7,100
3060	19,700
Total Cost	$83,200

5. WATERSHED LN-A

The largest portion of the developed land in this watershed will be low density residential when future development is complete. Of the 40 elements making up the existing major drainage system, only six require

improvement. Many of the existing reaches are natural channels in future open land areas which are integrated into the developed areas. Table VIII-9 describes each proposed improvement and compares the hydraulic capacity to future 10-year demand discharge for each modelled reach. (The demand discharges include flow contributions from tributary watersheds.)

Table VIII-9

WATERSHED LN-A, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1095	3' x 2' RCB	49	48
1120	36' x 7' RCB	2,800	2,675
1140*	Unlined Channel	1,029	2,685
1220*	Unlined Channel	1,351	2,603
1260	66" RCP	315	260
1270	66" RCP	343	254

*Existing unlined channel was realigned due to flooding of adjacent homes. Overflow in area of new alignment is not a problem so channel size was not increased.

All of the proposed improvements are identified as the City's financial responsibility. Table VIII-10 summarizes the estimated capital costs for each of these lines as well as priority numbers for lines other than road culverts.

Table VIII-10

WATERSHED LN-A, COST ESTIMATES AND PRIORITIES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1095	$ 13,500	N/A
1120	124,800	N/A
1140/1220*	75,000	16
1260	47,000	31
1270	126,900	31
Total Cost	$387,200	

*Realignment of natural channel.

6. WATERSHED LN-BC

This watershed is currently fairly well developed and when complete, the majority of the land will be used for commercial-retail purposes. Eight of the 46 elements in the existing major drainage system meet the criteria for improvement based on the inclusion of regulatory detention in areas tributary to Lines 4170, 4180, 4230 and 4240. By including this detention the increase in the 10-year peak discharge to downstream reaches, primarily to Line 4140 under the U.S. Highway 71 west access road, is minimized so that replacement is not required. This is the only watershed where regulatory detention is included in the model.

Table VIII-11 describes each proposed improvement and compares the hydraulic capacity to future 10-year demand discharge for each modelled reach.

Table VIII-11

WATERSHED LN-BC, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
4030	6' x 5' RCB	437	398
4040	5' x 5' RCB	375	362
4070	66" RCP	308	210
4080	54" RCP	197	140
4220	5.5' x 4.5' RCB	276	208
4250	8' x 4' RCB	198	173
4260	6.5' x 4' RCB	153	149
4310	36" RCP	52	52

Seven of the eight proposed improvements are identified as the City's financial responsibility. Line 4080 is considered to be the responsibility of the future developer of the area around it. Table VIII-12 summarizes the estimated capital costs for each of the City's lines as well as priority numbers.

Table VIII-12

WATERSHED LN-BC, COST ESTIMATES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
4030	$ 426,600	10
4040	333,000	10
4070	281,700	2
4220	*	N/A
4250	208,800	8
4260	160,000	8
4310	43,100	49
Total Cost	$1,453,200	

*Improved by City subsequent to existing capacity determination.

7. WATERSHED LN-DE

Currently, the residential areas of watershed LN-DE are basically developed and future development will add primarily commercial-retail

areas. Only 8 of the 44 elements of the existing major drainage system meet the criteria for improvement. Table VIII-13 describes each proposed improvement and compares the hydraulic capacity to future 10-year demand discharge for each modelled reach.

Table VIII-13

WATERSHED LN-DE, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
3050	9' x 7' RCB	792	665
3055	42" RCP	45	29
*3125	12' x 4' RCB	455	391
3200	8' x 5' RCB	420	347
3230	5' x 5' RCB	325	265
3240	4.5' x 4' RCB	270	228
3250	36" RCP	52	41
3251	30" RCP	32	27

*Add 6'x4' RCB adjacent to existing 6'x4'.

All of the proposed improvements in this watershed are identified as the City's financial responsibility. Table VIII-14 summarizes the estimated capital costs for each of these lines as well as priority numbers for lines other than road culverts.

Table VIII-14

WATERSHED LN-DE, COST ESTIMATES AND PRIORITIES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
3050	$ 80,200	N/A
3055	13,300	3
3125	15,200	7
3200	320,500	19
3230	480,600	19
3240	161,600	23
3250	26,200	23
3251	92,300	23
Total Cost	$1,189,900	

8. WATERSHED LN-F

In this largely developed watershed land use is classified primarily as low density residential. Only 4 of the 29 elements of the existing major drainage system meet the criteria for improvement. Table VIII-15 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-15

WATERSHED LN-F, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge
2090	8.5' x 5' RCB	523	493
2180	10' x 4.5' RCB	308	255
2210	66" RCP	237	190
2240	30" RCP	37	30

All four of the proposed improvements are identified as the financial responsibility of the City. Table VIII-16 summarizes the estimated capital costs for each of these lines as well as priority numbers for lines other than road culverts.

Table VIII-16

WATERSHED LN-F, COST ESTIMATES AND PRIORITIES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
2090	$ 27,300	N/A
2180	37,600	N/A
2210	118,200	9
2240	47,500	17
Total Cost	$230,600	

9. WATERSHED LS-AB

In this highly developed watershed, of primarily low density residential areas, 6 of the 65 elements of the existing major drainage system meet the criteria for improvement. Table VIII-17 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-17

WATERSHED LS-AB, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1050	30" RCP	49	38
1260	36" RCP	78	75
1390	54" RCP	238	185
1440	48" RCP	147	131
1450	3.5'x3' RCB	131	111
1460	36" RCP	75	61

All of the proposed improvements are identified as the City's financial responsibility. Table VIII-18 summarizes the estimated capital costs and priority numbers for each of these lines.

Table VIII-18

WATERSHED LS-AB, COST ESTIMATES AND PRIORITIES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1050	$ 31,100	47
1260	81,000	52
1390	46,600	29
1440	98,500	30
1450	117,400	30
1460	56,000	30
Total Cost	$430,600	

10. WATERSHED LS-C

Watershed LS-C is almost completely developed as low density residential areas with little area for future development. However, 10 of the 40 elements in the major drainage system for the watershed meet the criteria for improvement. Table VIII-19 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-19

WATERSHED LS-C, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1000	4'x3.5' RCB	138	135
1010	4'x3.5' RCB	123	117
1060	5'x2.5' RCB	105	99
2000	42" RCP	64	46
2030	2'x2' RCB	33	29
5000	10.5'x2' RCB	121	116
5010	5.5' x 2' RCB	102	102
5020	21" RCP	22	17
5050*	4'x2' RCB	78	74
5060*	3.5'x2' RCB	68	64

*These lines have already been partially improved with the extension of Bennington south of 137th St. Sizes shown are assumed for the purpose of modelling and do not reflect actual construction.

Six of the proposed improvements are identified as the City's financial responsibility. The remainder are considered to be the responsibility of future developers. Table VIII-20 summarizes the estimated capital costs and priority numbers for each of the City's lines.

Table VIII-20

WATERSHED LS-C, COST ESTIMATES AND PRIORITIES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1000	$101,600	13
1010	158,900	13
1060	27,300	N/A
2000	38,300	28
2030	15,100	N/A
5000	58,800	N/A
Total Cost	$400,000	

11. WATERSHED LS-D

This watershed is almost completely developed, primarily as low density residential areas. Of the 77 elements making up the existing major drainage system, 16 meet the criteria for improvement. Table VIII-21 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-21

WATERSHED LS-D, SUMMARY OF PROPOSED
SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1075	24" RCP	31	25
1110	10'x4.5' RCB	393	344
1190	5'x4' RCB	191	184
1300	30" RCP	51	34
1320	8'x5' RCB	438	388
1340	3.5'x2.5' RCB	60	56
1370	8'x3.5' RCB	365	299
1380	6'x4.5' RCB	294	294
1390	8'x4.5' RCB	314	280
1400	6'x5' RCB	306	269
1410	6.5'x5' RCB	292	258
1420	6.5'x4' RCB	278	248
1425	4'x4' RCB	174	169
1470	8'x3.5' RCB	202	165
1490	6'x3' RCB	124	92
1495	36" RCP	72	70

The City is identified as financially responsible for all of the improvements in this watershed. Table VIII-22 summarizes the estimated capital costs for each of these lines as well as priority numbers for lines other than road culverts.

Table VIII-22

WATERSHED LS-D, COST ESTIMATES AND PRIORITIES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1075	$ 16,300	6
1110	37,600	N/A
1190	109,000	12
1300	40,700	41
1320	161,600	N/A
1340	69,100	50
1370	151,200	1
1380	117,600	1
1390	194,000	1
1400	125,900	1
1410	145,100	1
1420	114,100	51
1425	28,700	51
1470	101,600	N/A
1490	59,900	43
1495	19,800	43
Total Cost	$1,492,200	

12. WATERSHED LS-EF

Watershed LS-EF is currently highly developed as a mixture of residential, office and commercial areas. Future development will add more commercial and industrial areas in available land. Eighteen of the 39 reaches of the existing major drainage system in this watershed meet the criteria for improvement. Table VIII-23 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach. (The discharges include flow contributions from Watershed LS-HIJK.)

Table VIII-23

WATERSHED LS-EF, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1040	30" RCB	49	44
1060	P.C.C. Lined Channel	1,200	687
*1070	16'x4' RCB	781	640
1075	8.5'x5' RCB	710	596
1080	10'x5' RCB	687	587
1085	13'x4' RCB	561	507
1140	13'x4' RCB	554	464
1160	14'x3' RCB	492	438
1170	36" RCP	93	53
1190	4.5'x2.5' RCB	65	62
1210	7'x3' RCB	184	183
1220	6.5'x2.5' RCB	199	169
1230	4.5'x2' RCB	77	63
1240	4.5'x2.5' RCB	119	105
1250	4.5'x2.5' RCB	95	90
1260	2.5'x2' RCB	49	45
1300	3'x2' RCB	51	37
1310	2.5'x2' RCB	43	35

*Add 6'x4' RCB adjacent to existing 10'x4'.

Fifteen of the proposed improvements in this watershed are identified as the City's financial responsibility. Of the others, Lines 1190 and 1210 are under U.S. Highway 71 west access road and are considered to be the state's responsibility while Line 1060 is left to a developer. Table VIII-24 summarizes the estimated capital costs for each of the City's lines as well as priority numbers for lines other than road culverts.

Table VIII-24

WATERSHED LS-EF, COST ESTIMATES AND PRIORITIES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1040	$ 259,800	39
1070	34,000	N/A
1075	76,600	4
1080	391,500	4
1085	182,600	4
1140	47,600	N/A
1220	134,100	11
1230	33,500	11
1240	262,300	11
1250	82,100	11
1260	255,100	11
1300	186,900	53
1310	70,100	53
Total Cost	$2,016,200	

13. WATERSHED LS-G

This watershed is largely undeveloped at this time. Future land use will be a mixture of low density residential and open areas (including the existing River Oaks golf course).

The existing major drainage system for this watershed consists of 39 reaches, 4 of which meet the criteria for improvement. (Several reaches east of Byers Road and south of 139th Street, although substantially undersized, were not included in improvements since future development apparently will change the existing system to the extent that realistic predictions of location, size and cost are not feasible at this time.) Table VIII-25 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-25

WATERSHED LS-G, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1310	3'x2' RCB	52	41
1600	36" RCP	60	48
1700	7.5'x2.5' RCB	163	148
1710	P.C.C. Lined Channel	211	132

Three of the improvements are identified as the City's financial responsibility. Line 1710 is considered to be a future developer's responsibility. Table VIII-26 summarizes the estimated capital costs for each of the City's lines as well as priority numbers for lines other than road culverts.

Table VIII-26

WATERSHED LS-G, COST ESTIMATES AND PRIORITIES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1310	$13,500	N/A
1600	13,300	33
1700	21,300	N/A
Total Cost	$48,100	

14. WATERSHED LS-HIJK

Although this watershed is almost completely developed as residential areas, 18 of the 65 reaches of the existing major drainage system meet the criteria for improvement. The two existing private detention facilities in the watershed, Reaches 2090 and 2350, remain in the system unchanged. Table VIII-27 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-27

WATERSHED LS-HIJK, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
2025	3'x2' RCB	48	31
2100	42" RCP	92	64
2101	30" RCP	53	31
2140	3'x2.5' RCB	82	70
2142	27" RCB	39	34
2170	4'x2.5' RCB	109	104
2180	4'x2.5' RCB	97	90
2190	2.5'x2.5' RCB	61	51
2200	2.5'x2.25' RCB	44	43
2220	24" RCB	25	25
2270	6'x2.75' RCB	123	102
2290	5'x2' RCB	63	58
2310	4'x3' RCB	111	108
2390	2.5'x2.5' RCB	69	62
2410	7.5'x4' RCB	306	280
2420	5.5'x4' RCB	294	270
2432	4'x2' RCB	31	17
2480	48" RCB	176	129

The City is identified as financially responsible for 17 of the proposed improvements in this watershed. Line 2390 is located in the S.L.S.F. Railroad right-of-way and is considered to be the railroad's responsibility Table VIII-28 summarizes the estimated capital costs for each of the City's lines as well as priority numbers for lines other than road culverts that have not been previously improved.

Table VIII-28

WATERSHED LS-HIJK, COST ESTIMATES AND PRIORITIES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
2025	$ 24,400	N/A
2100	55,600	32
2101	5,700	32
2140	84,300	20
2142	40,700	20
2170	*	N/A
2180	*	N/A
2190	*	N/A
2200	*	N/A
2220	7,100	N/A
2270	19,400	N/A
2290	16,600	N/A
2310	49,400	N/A
2410	265,100	21
2420	20,700	21
2432	15,100	22
2480	34,400	21
Total Cost	$ 638,500	

*Improved by City subsequent to existing capacity determination.

15. WATERSHED LS-L

Currently this watershed is a mixture of industrial and residential areas with substantial portions remaining to be developed. When development is complete the watershed will be primarily industrial.

Of the 38 elements in the existing major drainage system, 10 meet the criteria for improvement. Table VIII-29 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-29

WATERSHED LS-L, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1030	3.5'x1.75' RCB	42	39
1100	101'x4' RCB	600	472
1110	P.C.C. Lined Channel	450	384
1150	P.C.C. Lined Channel	338	248
1160	P.C.C. Lined Channel	240	141
1170	30" RCP	55	43
1225	P.C.C. Lined Channel	360	227
1280	5'x4.5' RCB	182	140
1300	8'x2.5' RCB	99	78
2010	12'x1.5' RCB	89	73

The City is identified as financially responsible for six of the proposed improvements. Of the other four, Line 1170 is located in the Kansas City Southern Railroad's right-of-way and the other three are considered to be future developers' responsibilities. Table VIII-30 summarizes the estimated capital costs for each of the City's lines as well as priority numbers for lines other than road culverts.

Table VIII-30

WATERSHED LS-L, COST ESTIMATES AND PRIORITIES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1030	$ 13,900	N/A
1100	27,900	N/A
1225	103,700	40
1280	159,300	14
1300	87,100	26
2010	27,000	N/A
Total Cost	$418,900	

16. WATERSHED LS-MNOP

This watershed is currently largely developed as low density residential areas. Future rezoning and development will add some commercial, industrial and medium density residential areas.

In this watershed, 22 of the 44 existing major drainage system elements meet the criteria for improvement. Table VIII-31 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-31

WATERSHED LS-MNOP, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1000	8.5'x3.5' RCB	403	369
1005	8'x3.5' RCB	375	352
1010	8'x3.5' RCB	375	335
1020	8'x3.5' RCB	365	316
1030	7.5'x3.5' RCB	338	294
1040	7.5'x3.5' RCB	319	273
1045	5.5'x3.5' RCB	274	267
1050	5'x3.5' RCB	243	242
1060	5'x3.5' RCB	263	220
1070	5.5'x3' RCB	248	185
1080	5'x3' RCB	164	153
1090	4.5'x2.75' RCB	135	122
1100	3'x2.75' RCB	90	87
1110	2.5'x2.5' RCB	71	69
4005	2.5'x2.25' RCB	55	50
4010	2.5'x2.25' RCB	54	45
4040	24" RCP	22	19
5000	4'x2' RCB	55	48
5020	3'x1.5' RCB	32	24
6000	3.5'x3' RCB	102	89
6010	3'x3' RCB	88	86
6040	36" RCB	83	79

Sixteen of the proposed improvements in this watershed are identified as the City's financial responsibility. Of the other six, two are

considered private and four are consider state's responsibility. Table VIII-32 summarizes the estimated capital costs for each of these lines as well as priority numbers for lines other than road culverts.

Table VIII-32

WATERSHED LS-MNOP, COST ESTIMATES AND PRIORITIES
FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1000	$ 134,700	34
1005	115,800	34
1010	151,200	34
1020	193,600	37
1030	281,700	37
1040	200,000	38
1045	88,800	38
1050	101,200	36
1060	161,500	36
1070	166,700	35
1080	143,200	35
1090	190,100	42
1100	171,500	42
1110	86,100	44
4040	5,900	N/A
6040	2,431,900	45
Total Cost	$2,529,100	

17. WATERSHED LS-Q

In this fully developed watershed of low density residential areas, 5 of the 48 reaches of the major drainage system meet the criteria for improvement. Table VIII-33 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach.

Table VIII-33

WATERSHED LS-Q, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1070	30" RCP	44	23
1090	4.5' x 5.5' RCB	309	281
1200	42" RCP	112	82
1204	36" RCP	83	70
5005	42" RCP	90	81

All of the proposed improvements are identified as the financial responsibility of the City. Table VIII-34 summarizes the estimated capital costs for each of these lines as well as priority numbers for lines other than road culverts.

Table VIII-34

WATERSHED LS-Q, COST ESTIMATES AND PRIORITIES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
1070	$ 21,500	27
1090	40,400	N/A
1200	32,500	54
1204	35,900	54
5005	13,300	48
Total Cost	$143,600	

18. WATERSHED OC-A

This largely undeveloped watershed will be primarily a mixture of low, medium and high density residential areas when future development is complete. Of the 42 reaches included in the existing major drainage system, 5 meet the criteria for improvement. The one existing detention facility, Reach 1290, is replaced in the system by a conveyance element and included in the proposed improvements. Table VIII-35 describes each

proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach. (The demand discharges include flow contributions from tributary watersheds OC-B and OC-C.)

Table VIII-35

WATERSHED OC-A, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
1260	72" RCP	364	359
1265	6'x6' RCB	414	356
1270	P.C.C. Lined Channel	450	319
1280	P.C.C. Lined Channel	240	195
1290	30" RCP	46	44

None of the proposed improvements in this watershed are identified as the City's financial responsibility. All are considered to be the responsibility of future developers.

19. WATERSHED OC-B

Future development will include low and medium density residential areas in this largely undeveloped watershed. Only 1 of the 14 elements of the existing major drainage system meets the criteria for improvement. Table VIII-36 describes the proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for the modelled reach.

Table VIII-36

WATERSHED OC-B, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
2095	24" RCP	39	32

The City is identified as financially responsible for the one proposed improvement. Table VIII-37 summarizes the estimated capital costs for this line and its priority number.

Table VIII-37

WATERSHED OC-B, COST ESTIMATES AND PRIORITIES FOR PROPOSED SYSTEM IMPROVEMENTS

Line No.	Capital Cost ($)	Project Priority No.
2095	$22,100	18

20. WATERSHED OC-C

Future development in this basically undeveloped watershed will be primarily low density residential. Four of the 23 reaches of the existing major drainage system meet the criteria for improvement. The two existing detention facilities in the watershed, Reaches 3020 and 3030, are replaced in the system by conveyance elements and are included in the proposed improvements. Table VIII-38 describes each proposed improvement and compares the hydraulic capacity to the future 10-year demand discharge for each modelled reach. (The demand discharges include flow contributions from tributary watersheds outside of the Grandview corporate limits.)

Table VIII-38

WATERSHED OC-C, SUMMARY OF PROPOSED SYSTEM IMPROVEMENTS

Line No.	Proposed Line Description	Proposed Line Capacity (cfs)	Future 10-Year Demand Discharge (cfs)
3020	P.C.C. Lined Channel	840	555
3030	P.C.C. Lined Channel	495	470
3060	4.5' x 3' RCB	165	142
3080	30" RCP	64	49

The City is not identified as financially responsible for any of the proposed improvements. Lines 3020 and 3030 are considered the developer's responsibility, while Lines 3060 and 3080 are identified as the state's responsibility.

* * * * *

IX – IMPROVEMENT PRIORITIES

PART IX

IMPROVEMENT PRIORITIES

A. GENERAL

Since there are many elements of the existing drainage system that do not provide an acceptable level of service, and all cannot be corrected "first," it is necessary for the City to establish priorities on an objective basis. The end objectives in setting these priorities should be to accomplish the following in order:

1. Provide an equal minimum level of service to all citizens as soon as possible.

2. Upgrade the drainage system as a whole to meet criteria standards for a higher level of service.

3. Improve the system in an order to yield the best practical benefit for the earliest investment.

4. Accomplish the improvement in an order such that any isolated improvement does not add to an existing problem or create a new problem elsewhere.

5. Directly benefit as many individual citizens as early as practical and reasonable to maintain continuing support for an orderly prioritized program of improving drainage service.

B. PROJECT ORGANIZATION

To accomplish this task for the City of Grandview individual reaches recommended for improvement were first grouped into a number of projects suitable for construction under a series of separate sequential contracts. A total of 54 separate municipal projects were identified with capital costs ranging from $13,300 to $801,100. The average project cost is approximately $215,900 and the median cost is $133,900. The projects tend to be concentrated in the watersheds that are already substantially developed as indicated by Table IX-1. (As noted in Part VIII of this report, the priority projects and costs do not include road culverts.)

Table IX-1

PROJECT PRIORITY DISTRIBUTION

Watershed	Number of Projects	Approx. Capital Cost per Watershed Acre*
B-A	2	$1,000
B-B	3	1,580
B-CD	0	N/A
B-E	0	N/A
LN-A	2	500
LN-BC	4	3,490
LN-DE	4	3,080
LN-F	2	590
LS-AB	4	870
LS-C	2	2,280
LS-D	7	2,880
LS-EF	4	7,360
LS-G	1	30
LS-HIJK	4	1,050
LS-L	3	710

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Table IX-1 - continued

Watershed	Number of Projects	Approx. Capital Cost per Watershed Acre*
LS-MNOP	8	9,090
LS-Q	3	450
OC-A	0	N/A
OC-B	1	140
OC-C	0	N/A

* Area within corporate limits of Grandview only.

After organizing and identifying the improvement projects, the PRIOR computer program, as described in Part III of this report, was employed to evaluate the project priorities.

C. PROJECT PRIORITIES

Project priority scores for the 54 projects, as determined by the program, range from a low of 6 to a high of 16. Table IX-2 indicates the projects' priority score distribution.

Table IX-2

PROJECT PRIORITY SCORE DISTRIBUTION

Priority Point Score	Number of Projects
16	2
15	1
14	2
13	2
12	3
11	7
10	8
9	15
8	9
7	4
6	1

Table IX-3, summarizes the priority ranking of the recommended improvement projects. It also indicates the watershed where the project is located, the

line or reach numbers included in the prject, the total number of points as determined by the PRIOR program, and the estimated project cost.

It is recommended that these projects be constructed according to the priority order established by this program, although it may be necessary for the City to periodically review, update and modify these priorities in response to the actual course of development.

Table IX-3

PROJECT PRIORITY RANKING

Priority Number	Project Number	Watershed	Line Nos. Included	Priority Points	Project Cost ($)
1	1105	LS-D	1370,1380,1390,1400,1410	16	733,800
2	601	LN-BC	4070	16	281,700
3	700	LN-DE	3055	15	13,300
4	1201	LS-EF	1075,1080,1085	14	650,700
5	201	B-B	1270,1310	14	226,500
6	1100	LS-D	1075	13	16,300
7	701	LN-DE	3125	13	15,200
8	602	LN-BC	4250,4260	12	368,800
9	800	LN-F	2210	12	118,200
10	600	LN-BC	4030,4040	12	759,600
11	1202	LS-EF	1220,1230,1240,1250,1260	11	767,100
12	1101	LS-D	1190	11	109,000
13	1000	LS-C	1000,1010	11	260,500
14	1501	LS-L	1280	11	159,300
15	202	B-B	1340,1370	11	220,100
16	500	LN-A	1140,1220	11	75,000
17	801	LN-F	2240	11	47,500
18	1900	OC-B	2095	10	22,100
19	702	LN-DE	3200,3230	10	801,100
20	1401	LS-HIJK	2140,2142	10	125,000
21	1402	LS-HIJK	2410,2420,2480	9	320,200
22	1403	LS-HIJK	2432	10	15,100
23	703	LN-DE	3240,3250,3251	10	280,100
24	200	B-B	1150,1170,1175	10	426,500
25	100	B-A	1110	10	76,200
26	1502	LS-L	1300	10	87,100
27	1700	LS-Q	1070	9	21,500
28	1001	LS-C	2000	9	38,300
29	902	LS-AB	1390	9	46,600
30	903	LS-AB	1440,1450,1460	9	271,900
31	501	LN-A	1260,1270	9	173,900
32	1400	LS-HIJK	2100,2101	9	61,300
33	1300	LS-G	1600	9	13,300
34	1600	LS-MNOP	1000,1005,1010	9	901,700
35	1604	LS-MNOP	1070,1080	9	309,900
36	1603	LS-MNOP	1050,1060	9	262,700
37	1601	LS-MNOP	1020,1030	9	475,300
38	1602	LS-MNOP	1040,1045	9	288,800
39	1200	LS-EF	1040	9	259,800
40	1500	LS-L	1225	9	103,700
41	1102	LS-D	1300	8	40,700

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TABLE IX-3 (continued)

Priority Number	Project Number	Watershed	Line Nos. Included	Priority Points	Project Cost ($)
42	1605	LS-MNOP	1090,1100	8	361,600
43	1106	LS-D	1490,1495	8	79,700
44	1606	LS-MNOP	1110	8	86,100
45	1607	LS-MNOP	6040	8	239,900
46	101	B-A	1290,1300,1310,1320	8	388,000
47	900	LS-AB	1050	8	31,100
48	1702	LS-Q	5005	8	13,300
49	603	LN-BC	4310	8	43,100
50	1103	LS-D	1340	7	69,100
51	1104	LS-D	1420,1425	7	142,800
52	901	LS-AB	1260	7	81,000
53	1203	LS-EF	1300,1310	7	257,000
54	1701	LS-Q	1200,1204	6	68,400

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